Bournemouth & West Hampshire Water

Climate Change Adaptation Plan 2011

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Climate Change Adaptation Plan Index

Climate Change Adaptation Plan

Executive Summary

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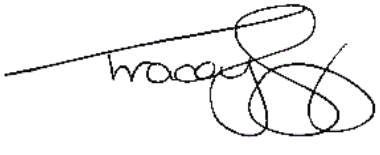
Approved:  Date: 18-01-2011

Executive Summary Index

1. Information on the Organisation

1.1. Functions, mission aims and objectives affected by climate change

- Bournemouth and West Hampshire Water (BWH) provide clean drinking water to about half a million people in an area from the outskirts of Poole to Southampton Water and from Bournemouth to just South of Salisbury. We supply approximately 184,000 households and 16,000 other properties, using a network of 2787km of water mains. We obtain up to 85% of our water from run of river abstractions on the Hampshire Avon and the Dorset Stour, and the remainder from boreholes. We do not treat wastewater; in our area the sewerage services are provided by Wessex Water and Southern Water. We have a long and successful tradition of supplying water.
- Our company strategy is to maintain our excellent record and to continue to improve our performance in response to customers' requirements.
- Our aim is to continue to be amongst the leading performers in the UK water industry by all measures, including sustainability, leakage, water quality, efficiency and customer service. We strive to position ourselves as a flagship organisation in order that our global shareholders can use us as a reference point for quality of service. By taking this approach we will benefit all our stakeholders both now and in the future.

1.2. Key strategic priorities for the business

- *Reliability of the water supply***.** It is fundamental that we provide a reliable, value-for money water supply to all our customers, meeting all the obligations placed on us in providing an essential public service. In order to ensure that we maintain a reliable service we need to make sure that our business has the ability to adapt to future climatic impacts.
- *Drinking water quality***.** Closely related to reliability, the water we supply must meet all the legal and regulatory standards of quality and safety.
- *Demand management.* An important focus for us is the application of a number of tools and techniques to manage demand, including the promotion of customer metering and water efficiency, and leakage control. By doing so we can postpone or avoid the need for new water resource development, which we acknowledge will be difficult in this locality because of the sensitivity of the water environment. For future planning we need to take into account the effects that the changing climate will have on the demand patterns of our customers.

- *Asset robustness and resilience*. In the face of climate change and similar uncertainties, we must ensure that all our assets are designed, operated and maintained in such a way to secure and protect the reliability and quality of the water supply. This may increase activity and expenditure in renewing and replacing water mains.
- *Sustainability***.** By operating in a sustainable way today we will ensure those future generations will also be able to operate without compromising the quality of the service.
- *Cost reduction*. We have succeeded in reducing our costs of operation in recent years, and we will continue to strive to make efficiencies in future. This is likely to become more difficult in the face of rising cost pressures and increasing climatic variability.
- *Corporate governance***.** It is essential that we operate to, and can demonstrate that we operate to, high standards of integrity, compliance and corporate governance. This principle applies to everything we do.
- *Price stability*. Our customers have told us that, with regard to pricing, they prefer stability to volatility. We will endeavour to achieve stability subject to the constraints of the price-setting mechanism, and any unforeseen new obligations.
- *Consistency and continuity*. We need to be consistent in delivering a good reliable service to our customers. They expect us to carry on undertaking our obligations in the same manner going into the future irrespective of the impacts of climatic variability.

2. Business preparedness before Direction to report was issued

- Climate change risks constitute just one of many to the operation of a water company, we have faced risks from extreme climatic events in the past and will continue to do so in future We are an essential public service and therefore have to ensure that we can provide a service under all conditions, and as such have systems and procedures in place to deal with threats to our service.

- The hazards resulting from the climate change impacts assessed in this report are covered in the company risk register and Water Safety Plan. With regards to the management of company assets and resources we also refer to the company business plan and the Water Resources Plan both of which were compiled taking climate change impacts into account.

- In our climate change impact assessment we have not identified any additional risks over and above those already included in our strategic business planning. Therefore we have no need for immediate investment for adaptation outside of a small number of schemes already programmed in for the next AMP (asset management period) that deal with flooding of certain parts of water treatment works.

- The company risk register and water safety plans already hold a complete breakdown of all company risks and the controls in place to deal with these. We have linked the hazards from the highest scoring climate change impacts to those found in the company risk register and water safety plan.

2.1. How are these risks and any mitigating action incorporated into the operation of the organisation?

- Building principles of sustainability and adaptability into the operation of our business ensures that we can achieve our goals of maintaining and improving service levels. As we have a corporate approach to risk identification and monitoring, we now review climate change related risks as part of the corporate risk management process.
- Table 2 below gives an outline of the mechanisms and processes we have in place to review risks in the corporate structure.

Table 2

Level	Process	Frequency	Comments
Strategic	Formal review of risk register and actions	2 per year	Formal process of review
Strategic	Review of key standards and policy objectives	As necessary	Based on political, regulatory and customer views
Company	Business plan	Every 5 years	Climate impacts to be taken into account for all business activities
Company	Water Resource Plan	Annual	Already takes climate change into account
Company	Review of Water Safety Plan	Annual	Climate change impacts to be included

3. Identifying risks due to the impacts of climate change

3.1. Evidence methods and expertise used to evaluate climate change impacts

- These impacts have been assessed and identified from the Water UK study, A Climate Change Adaptation Approach for Asset Management (2007)[1]. The Water UK study was carried out by MWH consultants and provides water companies with a list of risks, impacts and associated consequences that will arise as a result of changing climatic conditions.

3.2. Resource assigned to this assessment

- This report was written and compiled by company staff and cost an estimated £25, 000.00 taking into account staff time and on-costs.

3.3. Summary of approach

- For the purpose of this report we have used expert judgement from within the company to evaluate how the various climate change risks and hazards will affect the areas of operation across the business for the time periods 2020, 2050 and 2080. These areas include Water Resources, Infrastructure, Water Quality and Corporate Services. The highest scoring risks from the initial qualitative risk assessment were then investigated in more detail and all the hazards identified were cross referenced to existing risk assessments on the company risk register and Water Safety Plan.

- The initial risk assessment was completed on all the risks highlighted in the Water UK study, these were analysed for the three time periods in the UKCIP 09 scenarios. We have assumed the future climatic conditions will follow the medium emissions scenario as set out by UKCIP 09.

[1] Water UK A Climate Change Adaptation Approach for Asset Management Planning 41414874 V1.0

4. Assessing risks

4.1. Quantifying the impact and likelihood of the risks occurring

- This report covers potential impacts for the time periods 2020's 2050's and 2080's with the greatest emphasis and certainty around those impacts identified for the 2020's this ensures that we are consistent with our Water Resources Management Plan and Company Strategic Direction Statement which is the company strategy for the next 25 years.

- As it has been pointed out the company aims to maintain or improve its levels of service. Our risk assessment takes into account the consequences for service in combination with the likelihood of that consequence occurring in the future. We apply this to all the impacts identified in the Water UK[2] study across all areas of operation.

4.2. Levels of Consequence

- We have based our levels of consequence on the corporate consequence matrix used in all areas across the business. Relevant experts across the company used the matrix found in table 4.2 to score all the climate change impacts that were highlighted in the Water UK study.

[2] Water UK A Climate Change Adaptation Approach for Asset Management Planning 41414874 V1.0

Table 4.2

HARM ASSETS/SERVICES	REPUTATION	INTERNAL	DAMAGE	LOSS	SCORE
Minor damage, extra repairs or maintenance	-No impact on reputation	-Short run loss of a business system	-Minor -Few customer complaints	-Minor -£10K to £40K -Loss of supply to 1 to 1K customers	**1**
Minor deterioration in assets	-Minor local press release (one local paper)	-Short run loss of supply		-Loss of supply to 1K to 2K customers	**2**
Deterioration of assets requiring substantial maintenance/replacement, change to investment plan	-Broad local press coverage (Most local papers & radio)	-Long run Loss of IT\Comms - Fire in principle building Major overheads for staff	-Major -Multiple customer complaints	-Major -£40K to £100K -Loss of supply to 2K to 5K customers	**3**
Major maintenance/replacement of assets, reduction of Security of supply	-National press coverage -Local TV coverage	-Unable to control business system -Long run loss of business system		-Loss of supply to 5K to 10K customers -National press coverage	**4**
Failure of service/asset	-Long term loss of reputation	-Unable to control water supply -Long run loss of water supply	-Catastrophic - Undefendable prosecution	-Catastrophic -£100K + -Loss of supply to 10K+ customers -Loss of BWHW reputation	**5**

4.3. Likelihood score

- The likelihood of the company being affected by the various climate change impacts identified in the Water UK study are determined by assessing the most likely future climate scenarios for our area provided by UKCIP 09.

Table 4.3 Likelihood

LIKELIHOOD	Description	Score
Extremely unlikely	Almost no chance of occurring during the timeframe	**1**
Unlikely	Low probability will occur during the timeframe	**2**
Possible	Medium probability will occur in the timeframe	**3**
Likely	High probability will occur in the timeframe	**4**
Almost certain	Almost certain to occur in the timeframe	**5**

4.4. Risk Score

- Impacts are scored and classified using table 4.4 below. Risk score = Level of consequence x Likelihood. The highest scoring risks are analysed in further detail in part 3 of this plan.

Table 4.4 Risk Scores

Risk	Score
High Risk	15-25
Medium Risk	8-14
Low Risk	1-7

4.5. Confidence in the assessment

We use the table 4.5 below to assign a level of confidence to the assessment of risks.

Table 4.5 Confidence in the assessment

Confidence in assessment	Analysis	Attributes
High	Quantitative	Experienced similar conditions in the past. High degree of certainty in predicted future conditions
Medium	Qualitative	Experienced similar conditions in the past. Medium level of certainty in predicted future conditions
Low	Qualitative	Conditions fall outside of those experienced in the past. Low level of certainty in predicted future conditions

5. Uncertainties and assumptions

- We have a general idea of what conditions to expect however, projecting 50 plus years into the future presents us with a large degree of uncertainty.
- In order to get an idea of future conditions we have made a number of assumptions about future impacts facing the company.
- We acknowledge that these assumptions could change in light of new information and therefore we have mechanisms in place to allow for the assumptions used in this report to be reviewed and updated. This will ensure that we remain flexible and resilient to potential future hazards facing the organisation.

5.1. Main uncertainties in the evidence, approach and method used in the adaptation programme and the operation of the organisation

- The main uncertainties faced by the company are linked to the large variations in future climate scenarios and the robustness of data used to analyse the effects of climate on operations.

5.1.1. Evidence

- The impacts of climate change on the company have been taken from the Water UK study[3] . This provides general impacts for all water companies and therefore gives a broad range of possible impacts that could be experienced by a water company. Due to these impacts not being company specific there is a possibility that localised impacts could arise that have not been covered in the study.

- Data relating to the effects of climatic conditions on operations is not robust across all areas of the business. In future we need ensure that relevant data is collected in order to allow for more quantitative analysis.

5.1.2. Approach

- Our approach to climate change adaptation allows climate change risk to be managed through multiple interventions over time in some cases i.e. very long life assets a single intervention may be a better solution.

5.1.3. Method

- Our qualitative risk assessment has been carried out by relevant experts across the company. In future where possible we would like to use quantitative data to analyse climate related risks.

5.1.4. Operation of the organisation

- We are a small and local company compared to most other water which does increase operational risk slightly. Due to the small size of the company there are key staff members across the organisation that hold valuable information and expertise that is vital to the carrying out of our functions. This is especially the case when determining the effects of extreme weather on various areas of the business.

- Information needs to be recorded and stored in order that the organisation is less reliant on key members of staff. This plan will serve as a catalyst to improve the way operational data is stored and managed with regards to the effects of extreme weather.

[3] Water UK A Climate Change Adaptation Approach for Asset Management Planning 41414874 V1.0

5.2. Assumptions that have been made when devising the programme for adaptation

5.2.1. The water industry

- We assume that the water industry will exist in future in its current form with the same regulators and regulatory regime that we currently experience.

5.2.2. Emissions scenarios

- Future climatic conditions will result from an atmospheric carbon content equal or less than the medium emissions scenarios provided by UKCIP. We assume that the government will achieve the targets set in the Climate Change Act 2008 to reduce emissions by 80% by 2050.

5.2.3. Levels of service

- We will continue to maintain or improve our levels of service based on the wishes of our customers and key stakeholders.

5.2.4. Assessment of impacts

- Assessments of impacts on areas of operation have been carried out by experts in those fields and their judgement of the impacts and effects constitutes the best possible information available at present.

5.2.5. Implementation of policies and procedures

- We assume that the procedures we are putting in place to mainstream climate change adaptation into the everyday decisions and planning will be effective in achieving this end. We will review these procedures on a regular basis to ensure that climate change adaptation becomes integral to the operation of the business.

6. Addressing current and future risks due to climate change-summary

Business Function	Climate variable	Primary impact of climate variable	Thresholds above which this will affect the organisation	Likelihood of threshold being exceeded in the future (medium term 2020's) and confidence in the assessment	Potential impacts on organisation and stakeholders	Proposed action to mitigate impact	Timescale over which risks are expected to materialise and action is planned
Water Resources	Drought	Reduced availability of resource	None identified in the medium term to be held under review (assessed in company Water Resource Plan)	Unlikely. Medium level of confidence in the assessment of this risk	Reduced available supply. Changes in peak demands. Lower river levels. Lower groundwater levels. Lower yields from sources. Reduction in security of supply. Reduced borehole performance.	Company drought plan and Water Resources Management Plan	Long term post 2050
	Temperature rise	Increased demand	None identified in the medium term to be held under review (assessed in company water Resource Plan)	Unlikely. Medium level of confidence in the assessment of this risk	Demand outstrips supply and changes in customer behaviour	Company drought plan and Water Resources Management Plan	Long term post 2050
	Flood	Surface flooding	None identified in the medium term to be held under review (assessed in company Business Plan)	Unlikely Medium level of confidence in the assessment of this risk	Loss of water resource assets. High intensity rainfall events causing reduced groundwater recharge due to compaction of upper layer of soil	Assessed in company Business plan. Schemes in place in AMP 5 to mitigate risks to parts of treatment works under threat from surface flooding.	Medium term post 2020 Flood defence for vulnerable parts of treatment works to be completed in AMP 5
	Sea level	Inundation	None identified to be held under review	Extremely unlikely Medium level of confidence in the assessment of this risk	Increase in the flood potential of rivers when high flows and tides coincide	None at present impact will be kept under review	Long term post 2050

Water Quality	Drought	Reduced raw water quality	None identified to be held under review	Unlikely Medium level of confidence in the assessment of this risk	Low flows leading to sedimentation and blockages. Reduced raw water volumes reducing dilution. Intermittent supply causing silts and debris being flushed from storage into the system. More inversions leading to greater cryptosporidium accumulation. Lower flow rates leading to deposition and reduced raw water quality.	None at present impact will be kept under review	Long term post 2050
	Temperature rise	Increased algal growth	None identified to be held under review	Possible. Medium level of confidence in the assessment of this risk	Increased algal growth and other biological issues	None at present impact will be kept under review	Medium term post 2020
	Flood	Reduced raw water quality	None identified to be held under review	Unlikely Medium level of confidence in the assessment of this risk	Increased runoff leading to higher sediment loads	None at present impact will be kept under review	Long term post 2050
	Sea level	Reduced raw water quality	None identified to be held under review	Extremely unlikely. Medium level of confidence in the assessment of this risk.	Inundation	None at present impact will be kept under review	Long term post 2050
Infrastructure	Drought	Increased burst mains	None identified to be held under review	Unlikely. Medium level of confidence in the assessment of this risk	Pipe failure due to de-pressurisation. Low river/groundwater below intake/pump levels	None at present impact will be kept under review	Long term post 2050
	Temperature rise	Increased asset deterioration	None identified to be held under review	Unlikely. Medium level of confidence in the assessment of this risk	Higher average and peak temperatures affect structures and buildings. Possible reductions in asset life and operational ability of assets. Ground movement leading to increased mains failures.	None at present impact will be kept under review	Long term post 2050

	Flood	Surface flooding	Risks identified in the PR09 business plan to be held under review	Unlikely. Medium level of confidence in the assessment of this risk	Loss of assets and service failure through direct flooding. Storm events leading to loss of power supply. Increased storm water leading to increased pump usage and accelerated deterioration. Higher flows posing risk to pipe bridges	Assessed in company Business plan. Schemes in place in AMP 5 to mitigate risks to parts of treatment works under threat from surface flooding.	Medium term post 2020 Flood defence for vulnerable parts of treatment works to be completed in AMP 5
	Sea level	Inundation	None identified to be held under review	Extremely unlikely. Medium level of confidence in the assessment of this risk.	Inundation of assets	None at present impact will be kept under review	Long term post 2050
Corporate Services	Drought	Financial	None identified to be held under review	Possible. Medium level of confidence in the assessment of this risk	Financial impact of dealing with drought	Company drought plan	Medium term post 2020
	Temperature rise	Working in extreme conditions	None identified to be held under review	Possible. Medium level of confidence in the assessment of this risk	Working in extreme conditions	None at present impact will be kept under review	Medium term post 2020
	Flood	Access to sites	None identified to be held under review	Unlikely. Medium level of confidence in the assessment of this risk	Access to sites	None at present impact will be kept under review	Long term post 2050
	Sea level	Migration of population	None identified to be held under review	Extremely unlikely Medium level of confidence in the assessment of this risk	Migration of population	None at present impact will be kept under review	Long term post 2050

7. Barriers to implementing the adaptation programme

Implementation of the climate change adaptation plan is essential if we are to ensure the resilience of our business. We have not at present identified any immediate actions that need to be carried out to deal with a risk to the business arising from climate change. Implementing the programme is a process of setting up mechanisms within the organisation that will allow for accurate monitoring and evaluation of the impacts of climate on the business and for this to be successful the following barriers will need to be overcome.

7.1. Behaviour change

This report serves to highlight the areas where we could expect an impact in future. The significance of this is that we need to put in place measures to ensure that we are constantly monitoring and evaluating the effects of climate on our everyday operations. An important aspect of getting these measures in place across the business is the behavioural change needed in staff. The entire organisation needs to buy in to the concept of climate change adaptation in order to ensure resilience to the impacts.

7.2. Reliability of data

Sound data is needed to ensure that we are following the correct programme of measures in our climate change adaptation strategy. If the data used to determine our strategy is unreliable we will not be able to make informed decisions. This will lead to incorrect and unsuitable actions being taken or no action being taken when action is needed.

7.3. Regulatory constraints

All water companies are subject to a high degree of regulatory scrutiny. When making any investment decisions, we have to prove that our actions are justified and cost beneficial. We also need to use our resources in the most efficient manner. Therefore we need to be certain that when an investment decision is made it is based on the best evidence possible. Due to the uncertainty around the predicted future conditions and lack of data in certain areas, it becomes difficult in certain cases to justify actions that may be needed to address future climate change.

We need to maintain good communications with our various regulators and ensure that they are communicating with one another. As a result of our various regulators having their own specific areas of interest there is a possibility that in future an output from one regulator may contradict that required by another.

7.4. Carbon Impact

Many adaptation measures that will be required in future may be hard engineering solutions. These may have a significant carbon footprint and thereby accelerate climate change

8. Reporting and Review

- The Climate Change Adaptation Plan (CCA) is an iterative document we have incorporated climate change adaptation into our corporate reporting structures, this will ensure that any climate change related issues are identified and the subsequent adaptation actions are closely monitored.

Table 8.1 Monitoring outcome, implementation and residual risks

Action	Responsibility	Mechanism	Frequency
Monitoring the outcomes of the adaptation programme	Executive	Climate change adaptation plan review	Yearly
Monitoring and incorporation of climate change threshold into future risk assessment	Regulation	5 year Regulatory Business Plan	Every 5 years
Monitoring the residual risks on stakeholders and the organisation	Regulation	5 year Regulatory Business Plan	Every 5 years

Table 8.2 Company processes to monitor the implementation of adaptation

Level	Process	Frequency	Comments
Strategic	Formal review of risk register and actions	2 per year	Formal process of review
Strategic	Review of key standards and policy objectives	As necessary	Based on political, regulatory and customer views
Company	Business plan	Every 5 years	Climate impacts to be taken into account for all business activities
Company	Water Resource Plan	Annual	Already takes climate change into account
Company	Review of Water Safety Plan	Annual	Climate change impacts to be included

9. Recognising opportunities

- We recognise that not all the impacts of climate change are negative; we will continue to review and update our risks when new evidence comes to light.
- *Drought*: We have not identified any opportunities as a result of drought at present
- *Temperature*: Increased temperatures could have a positive effect on water treatment making the process more efficient.
- *Flood*: We have not identified any opportunities that will arise as a result of flooding at present
- *Sea level Rise*: We have not identified any opportunities that will arise as a result of sea level rise at present

10. Further information for the assessment of this plan

This section links the 8 criteria that Cranfield Risk will be assessing with the relevant parts of the climate change adaptation report.

Cranfield key attributes of CCA reporting

Key attributes of RA	Assessed in	Comments
Climate change risk assessment is a clear component of corporate risk appraisal	Part 4.2 Implementing adaptation into business practice	We have included climate change risk to the company risk register to be reviewed as part of the corporate risk management process. Climate change is already taken into account in Water Resources Management Plans and company asset management plans
Climate change risk assessment allows Reporting authority to make evidence based decisions on adapting to climate change	Part 3 summary of risks	Qualitative risk assessment was undertaken to highlight areas that need to be assessed in more detail during the next round of regulatory planning.
Demonstrate use of relevant appropriate data, information, knowledge and tools	Part 1.7 Part 2 Approach Part 3 Summary of risks Appendices 1 and 2	Expert judgement was used in conjunction with the UKCIP 09 climate change scenarios
Climate change risk assessment and adaptation measures explicitly consider uncertainties	Part 5 uncertainties and assumptions	Asset management (AMP) plans and Water Resource Plans (WRMP) have to take uncertainty into account
Climate change risk assessment generates priorities for action	Part 3 Summary of risks Part 3.3.7	The qualitative risk assessment has highlighted areas that could possibly pose threats in the future. These will be taken into account in the next round of regulatory planning
Climate change risk assessment identifies opportunities	Part 3.4 Opportunities as a result of climate change	Climate change related risks are part of a number of risks faced by the company. We have not identified any opportunities in this iteration of the CCA report. This will be held under review
Clear demonstration of flexible adaptation measures	Part 2 Approach Part 7.5	Water companies are encouraged to be flexible through long term regulatory planning.
Monitoring and evaluation of adaptation effectiveness	Part 7 Monitoring the outcome of the adaptation programme	Climatic impacts are already taken into account in most areas of operation however this report provides an opportunity to formalise the assessment of climate change risk is embedded in our day to day operations

Climate Change Adaptation Plan

Part 1

Company functions

Part 1 Index

1. Company functions impacted by climate change

1.1. Introduction

We are required to assess the climate change risks facing the operation of our business. As we are a provider of an essential service on which the public depends, we have a duty to ensure we will be able to supply clean safe drinking water under uncertain future climatic conditions. The supply of safe reliable drinking water is the core function of our business. Furthermore we need to ensure that we manage demand and maintain asset robustness and resilience. We also need to conduct our business in a sustainable manner, strive to reduce costs while maintaining good corporate governance, price stability, consistency and continuity.

1.2. Company overview

Bournemouth and West Hampshire Water (BWH) provide clean drinking water to about half a million people in an area from the outskirts of Poole to Southampton Water and from Bournemouth to just South of Salisbury. We supply approximately 184,000 households and 16,000 other properties, using a network of 2787km of water mains. We obtain up to 85% of our water from run of river abstractions on the Hampshire Avon and the Dorset Stour, and the remainder from boreholes. We do not treat wastewater; in our area the sewerage services are provided by Wessex Water and Southern Water. We have a long and successful tradition of supplying water. Our predecessors Bournemouth and District Water and West Hampshire Water were established by Acts of Parliament in 1863 and 1893 respectively, and were merged in 1994. .

Our company strategy is to maintain our excellent record and to continue to improve our performance in response to customers' requirements. Compared with most water companies, we are a small and local business. This has advantages in terms of responsiveness, but it also increases operational risk and our vulnerability to extreme climatic events. Our aim is to continue to be amongst the leading performers in the UK water industry by all measures, including sustainability, leakage, water quality, efficiency and customer service. We strive to position ourselves as a flagship organisation in order that our global shareholders can use us as a reference point for quality of service. By taking this approach we will benefit our stakeholders both now and in the future.

1.3. Company functions, mission aims and objectives

The main function of our business is to supply safe, reliable, high quality water to our customers. To ensure that we can continue to do this we need to take all risks to service into account and ensure we have controls in place to deal with these risks. This report serves to identify the effects of climate change impacts on our business and serves as a means of mainstreaming climate change into everyday business activities. Below we have listed our key concerns.

- Reliability of the water supply

  It is fundamental that we provide a reliable, value-for money water supply to all our customers, meeting all the obligations placed on us in providing an essential public service. In order to ensure that we maintain a reliable service we need to make sure that our business has the ability to adapt to future climatic impacts.

- Drinking water quality

  Closely related to reliability, the water we supply must meet all the legal and regulatory standards of quality and safety.

- Demand management

  An important focus for us is the application of a number of tools and techniques to manage demand, including the promotion of customer metering and water efficiency, and leakage control. By doing so we can postpone or avoid the need for new water resource development, which we acknowledge will be difficult in this locality because of the sensitivity of the water environment. For future planning we need to take into account the effects that the changing climate will have on the demand patterns of our customers.

- Asset robustness and resilience

  In the face of climate change and similar uncertainties, we must ensure that all our assets are designed, operated and maintained in such a way to secure and protect the reliability and quality of the water supply. This may increase activity and expenditure in renewing and replacing water mains.

- Sustainability

  By operating in a sustainable way today we will ensure those future generations will also be able to operate without compromising the quality of the service.

- Cost reduction

  We have succeeded in reducing our costs of operation in recent years, and we will continue to strive to make efficiencies in future. This is likely to become more difficult in the face of rising cost pressures and increasing climatic variability.

- Corporate governance

  It is essential that we operate to, and can demonstrate that we operate to, high standards of integrity, compliance and corporate governance. This principle applies to everything we do.

- Price stability

  Our customers have told us that, with regard to pricing, they prefer stability to volatility. We will endeavour to achieve stability subject to the constraints of the price-setting mechanism, and any unforeseen new obligations.

- Consistency and continuity

  We need to be consistent in delivering a good reliable service to our customers. They expect us to carry on undertaking our obligations in the same manner going into the future irrespective of the impacts of climatic variability.

The climate change adaptation plan is a means to ensure climate change is considered as a factor in all business planning and activities. It will serve to increase the resilience of the company and is a way of ensuring we protect our customers both now and in the future. We see this plan as a live document, which will be continually updated to ensure that we are completely up-to-date with the latest information that is relevant to climate change risk management.

1.4. Areas of operation and functions affected by climate change

This section describes the manner in which our company operates and the climatic conditions that are predicted for our region and give a summary of the main impacts that these different climatic conditions have on the company.

Weather and climate affect economic activity and everyday lives in many ways. As the climate continues to change, the impacts will affect almost every aspect of our business and will result in unexpected costs as well as changes to the operating environment. If we plan ahead we can minimise the threats and take advantage of the opportunities created by the current and future climate. Our climate change adaptation strategy takes a high-level, strategic and holistic view of the risks and opportunities to our organisation. This is an iterative document, which will constantly evolve as our knowledge of future climatic impacts related to climate change improves.

1.4.1. Key climate change impacts

For the purpose of this report we have used the Water UK methodology[4]. Following this we have divided the predicted climate change scenarios into four headline climate change risk groups.

1. Drought

   This includes the affects of lower rainfall levels, lower ground water levels, and reduced soil moisture and infiltration levels.

2. Temperature rise

   Higher peak and average temperature, higher levels of evaporation.

3. Flooding

   Increased intensity of summer rainfall, increased winter rainfall, greater rainfall intensity, higher groundwater levels and increased soil moisture.

4. Sea level rise and storm surges.

More information on climatic predictions for South West England can be found in Appendix 1.

[4] Water UK A Climate Change Adaptation Approach for Asset Management Planning 41414874 V1.0

1.4.2. Impacts of climate change on the company

Each of the headline climate change risk groups described in 1.4.1 are made up of a number of climate change impacts which in turn give rise to consequences and hazards that could be faced by the company as a result of:

- fluctuations in the availability of resources
- impacts on infrastructure and processes

The headline consequences and hazards include:

- loss of supply
- failure of assets
- increased demand
- business consequences such as the risk to company shareholders and access to finance
- Socio-economic consequences including effects that will arise as a result of changing behaviours, working patterns, social norms, population dynamics and economic activities
- Supply chain, possible risks to suppliers that have a bearing on the company carrying out its functions

These are described in more detail in section 3 of this report.

1.5. Areas of operation affected climate change impacts

The functions of the business encompass a number of interlinked areas of operation across all our business activities. For the purpose of the adaptation report we have grouped the functions into four areas of operation within the business, these being:

1.5.1. Water resources

1.5.2. Water quality

1.5.3 Infrastructure

1.5.4. Corporate functions

These areas operate together to allow the business to carry out its activities and meet its objectives and encompass all we do. All these areas need to have the potential to adapt or be adapted to cope with the environmental and social pressures that will arise as a result of future climate change.

Responses to these impacts include adaptation, investment and changes of behaviour. Below we provide a summary of the areas of operation we have listed and described the key impacts on these areas. We have based our assessment on the climate change risks identified in the Water UK methodology[5].

1.5.1. Water resources

Water resources involve the sustainable management of our run of river and groundwater abstractions and include:

- Forecasting demand and yields to ensure that supply meets demand
- Ensuring that our abstractions do not have a disproportionate impact on the environment.

Changes in weather patterns, temperature and socio economic factors will have a marked effect on this area of our business.

It can be seen from predictions that the overall increased precipitation in the winter will balance out the decreased summer precipitation. Meaning that annual average rainfall will remain similar to what we currently experience. It is however, important to note that the changes we are likely to see will occur at the extreme ends of the flow distribution profile. Summer flows are likely to be lower than we are used to seeing and as a result of more extreme winter rainfall events we are likely to see an increase in higher flow percentiles.

[5] Water UK A Climate Change Adaptation Approach for Asset Management Planning 41414874 V1.0

Decreased summer rainfall

This will lead to reduced runoff and therefore a resulting reduction in river flows. As we have limited surface storage and 85 % of our abstractions rely on the instantaneous performance of our run of river sources, extreme low flows could reduce our ability to abstract water in a sustainable manner.

Temperature increases
Increases in temperature have a direct effect on demand; periods of prolonged hot weather will have an impact on peak demands.

Socio-economic consequences

These present the greatest uncertainty with regards to water resources. It is our experience that increased demand correlates to increases in temperature. With predicted warmer summer temperatures there is a possibility that we would experience an increase in demand.

Our supply system already experiences high peak demands during the summer months with a peak to average ratio that is one of the highest in the country. This is mostly due to discretionary use such as garden watering and the fact that our residential profile is dominated by the most affluent socio-economic groups with a high incidence of detached houses and large gardens. In our 2007 drought plan we estimated that the number of overnight visitors to Bournemouth during the peak months of July and August was over 50 000 people. This excludes day visitors and is approximately 12% over our usual residential population. With higher summer temperatures we could see even greater numbers of people visiting our area.

A major part of our area of supply includes the South East Dorset conurbation, which is the second largest urban area in South West England. It is also one of the fastest growing, experiencing a large amount of in migration. The population of the area is characterised by a high proportion of elderly people and forecasts point towards the number of elderly residents increasing in future. The area is also characterised by an increasing number of smaller and single occupancy households[6]. This has implications for household per capita consumption moving into the future.

[6] The Draft Regional Spatial Strategy for the South West 2006-2026:
June 2006 the South West Regional Assembly

1.5.2. Water quality

Water quality is concerned with all matters related to the application and interpretation of the water quality regulations. The following activities form part of the water quality function:

- water quality sampling at all phases of the water distribution cycle
- monitoring and forecasting from collected data
- reacting to any failure in water quality standards including short term mitigation and trending for long term issues
- dealing with customer complaints, queries and concerns
- implementing the requirements of the water fittings regulations and notifications approval as well as on site inspections of plumbing

Higher temperatures and *lower summer rainfall*

This will result in increased evaporation and a shortened recharge period. The drier summers will also affect the amount of runoff entering our rivers. Increased solar radiation and decreased cloud cover could also lead to enhanced macrophyte growth and algal blooms. Long periods of low flow could also have an affect on the amount of dissolved oxygen in river water with implications for river biota.

High intensity rainfall events

These could lead to high pulsed loads of nitrogen, phosphates micro-organisms and pesticides during the autumn. We also experience turbidity problems caused by suspended mineral solids after periods of intense rainfall.

Socio economic consequences

This will have an affect on this area as land use practices may change would also lead to new challenges to existing treatment processes.

1.5.3. Infrastructure

Below ground infrastructure

Below ground infrastructure includes the entire network of mains used to transport water through the entire production cycle

The functions of this area include:

- The distribution of wholesome water
- Continuous reliable water supply through a network of water mains and infrastructure
- Maintenance of network of underground mains of varying ages, some up to 100 years in age from 12.5mm to 900 mm constructed from a variety of different materials due to their age and different responses to temperature and ground conditions
- Supply of around 151 mega litres (151,000,000 litres) per day
- Effective utilisation of the network to maintain levels of service
- To ensure leakage remains at an acceptable level
- Utilise resources in an effective manner through optimal network management

Higher temperatures and lower precipitation

This will increase pressures on our system through increased demands having an impact our ability to meet levels of service. Below ground assets are most vulnerable from ground movement as a result of changes in temperature and soil moisture. Ways of mitigating these effects such as increasing trench depth may need to be considered in future.

Drought

During times of drought the increase in fires could stress the network from fire service demand.

Flooding

The most common impacts will be third party effects (sewers and storm runoff). There is also a possibility that we could face transport issues due to flooding of access routes.

Above ground infrastructure

Above ground infrastructure includes all treatment works, pumping stations, reservoirs and other management assets such as offices, IT equipment and vehicles.

The function of above ground infrastructure includes:

- To enable the company to abstract and treat our licensed amounts of abstracted water to a wholesome quality.
- Supply water, through a system 6 treatment works, 19 source and intake and distribution pumping stations pumping stations, 23 service reservoirs and 4 water towers.
- Maintain assets through a strategy of proactive and reactive management, allowing the supply of water to be continuous and resilient.

Flooding

Flooding is taken into account in the design of all key above ground assets. Currently these are designed to be resilient to floods of up to a 1 in 200 year magnitude. There are schemes in place in the AMP 5 period set to improve flood resilience to what is currently considered to be 1 in 1000 years for those assets identified as being vulnerable to flooding. When the knowledge of future flooding scenarios becomes more accurate it is possible that this may need to be reassessed and new design standards or flood mitigation measures implemented. There are also possible site access implications. In future a review of the suitability of vehicles may be necessary.

Temperature increases

Our above ground infrastructure is designed for the current climatic conditions. Although design specifications allow for deviation from average these extremes usually only occur for short periods of time. In future it is possible that the capability of our current assets could be put under stress through longer duration extreme weather. Future planning needs to take into account the possibility of increased construction costs to allow assets to cope with new temperature ranges.

As a company we keep a risk register for all assets. Flooding constitutes one of many potential risks that could cause interruptions to supply. Risks are quantified in the register for each case giving the severity and likelihood of occurrence as well as giving the means by which each failure mode can be managed, mitigated or overcome. In general terms because of the numerous causes of asset failure we manage our system with adequate flexibility to cope with this and reduce the effects on customers.

1.5.4. Corporate functions

The corporate function is divided into two parts, namely corporate services and revenue services. Our corporate services include IT, HR, Quality, Environment, Health and Safety, Finance and Risk Management. Revenue Services includes all services associated with customer billing and payment processing. The corporate function of the business largely deals with the company staff and interactions with customers.

Socio-economic
The socio-economic consequences resulting from the various climate change risks will have the greatest implications for the corporate function. These include changes in population dynamics such as a large inwards migration of older retired people. This could have implications for managing our network arising from changes in diurnal use patterns.

Changing climatic conditions
Changes in conditions will lead to changes in work patterns and customer behaviour. Changing demographics with a larger number of smaller single occupancy households in our area as pointed out in the South West Regional Strategy will have implications for demand planning.

Although the Corporate function will be affected by climatic events it is important to note that these impacts are going to happen over a long period of time. People and working practices will have time to adapt to these changes as they are not going to occur overnight.

1.6. Summary of climate change impacts and their consequences on water company areas of operation

This section provides a summary of the consequences identified in the Water UK[7] study that have the potential to affect the areas of operation listed in section 1.5. These impacts are generalised for all water companies and not specific to one single company.

Area of operation - water resources

Risk group	*Consequences*
Drought	Reduced available supply
	Changes in daily peak demands
	Low river levels
	Lower groundwater levels
	Lower yields from sources
	Pressure on surface storage
	Reduction in security of supply
	Reduced groundwater levels affecting borehole performance

Risk group	*Consequences*
Temperature	Changes in demand and customer behaviour

Risk group	*Consequences*
Flood	High intensity rainfall events compact upper layers of soil layers causing increased runoff reducing groundwater recharge

[7] Water UK A Climate Change Adaptation Approach for Asset Management Planning 41414874 V1.0

Area of operation - water quality

Risk group	*Consequences*
Drought	Low flows leading to sedimentation and blockages of pipes
	Reduced raw water volumes reducing dilution
	More frequent inversions leading to greater cryptosporidium accumulation
	Lower flow rates leading to deposition and reduced raw water quality
	Low flows leading to sedimentation and blockages
	Intermittent supply causing silts and debris being flushed from storage towers into the system

Risk group	*Consequences*
Temperature	Increased algal growth and other biological issues

Risk group	*Consequences*
Flood	Increased runoff leading to higher sediment loads
	Contaminants entering the supply system through infiltration

Impact	*Consequences*
Sea level	None from present information-we will continue to monitor the effects

Area of operation – infrastructure

Impact	*Consequences*
Drought	Pipe failure due to de-pressurisation Low river/groundwater below intake/pump levels

Impact	*Consequences*
Temperature	Higher average and peak temperatures affect structures and buildings, possible reductions in asset life and operational ability of assets Ground movement leading to increases in mains failures

Impact	*Consequences*
Flood	Loss of assets and service failure through direct flooding Storm events leading to loss of power supply Increased storm water leading to increased pump usage and accelerated deterioration Higher flows could pose risks to pipe bridges

Impact	*Consequences*
Sea level	Inundation

Area of operation – corporate services

Impact	*Consequences*
Drought	Financial impact of dealing with drought

Impact	*Consequences*
Temperature	Working in extreme temperatures

Impact	*Consequences*
Flood	Access to sites

Impact	*Consequences*
Sea level	None from present information-we will continue to monitor the effects

1.7. Thresholds above which climate change climate change and weather events will pose a threat to the business

All extreme weather poses a threat to our business in some way. We have always experienced extreme weather in the past and continue to do so in the future with certain types of extreme weather becoming more prevalent as a result of climate change. This section provides an estimation of future climatic conditions and compares them with conditions experienced in the past.

1.7.1. Predicted climate change impacts based on the UKCIP09 medium emissions scenarios[8]

We have used the UKCIP scenarios to evaluate potential future climatic conditions for our region. We obtained long term rainfall and temperature data from the Met Office for Hurn station.[9]

In the charts below we have compared:

- summer mean daily maximum temperatures
- annual mean precipitation
- winter mean precipitation
- summer mean precipitation

To get an indication of what future climatic conditions could be, we have added or subtracted the percentage change provided in the UKCIP 09 predictions from the baseline values provided for each of the parameters mentioned above.

In all cases we have plotted the *historic average data (1957-2009*) as a baseline. We have then plotted the *high, medium* and *low* estimates for each parameter based on the predicted change values provided in the UKCIP 09 medium emissions scenarios for the time periods 2020, 2050 and 2080.

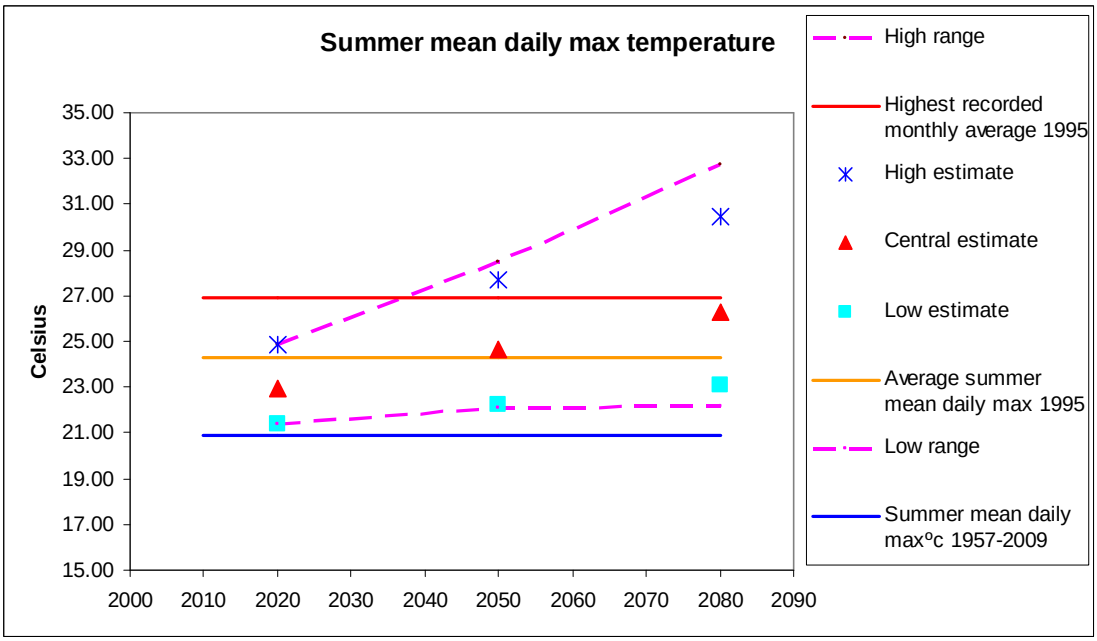
The *high* and *low range* values have been estimated from the highest and lowest values of the most likely range of conditions provided in UKCIP 09 medium emissions scenarios. This gives us an indication of the range of possible future conditions.

We also plot the highest and lowest recorded historical values for each of the parameters. This provides a means of comparing the future conditions with the extremes of conditions that have been experienced in the past.

[8] http://ukclimateprojections.defra.gov.uk/content/view/2271/528

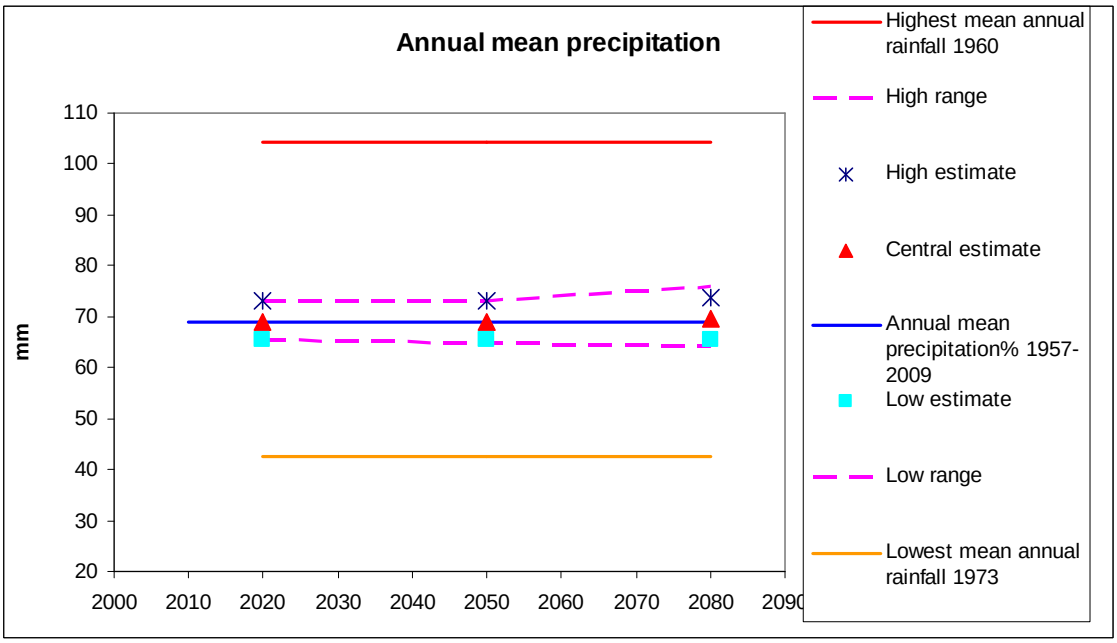
[9] http://www.metoffice.gov.uk/climate/uk/stationdata/hurndata.txt

1.7.2. Summer mean daily maximum temperature



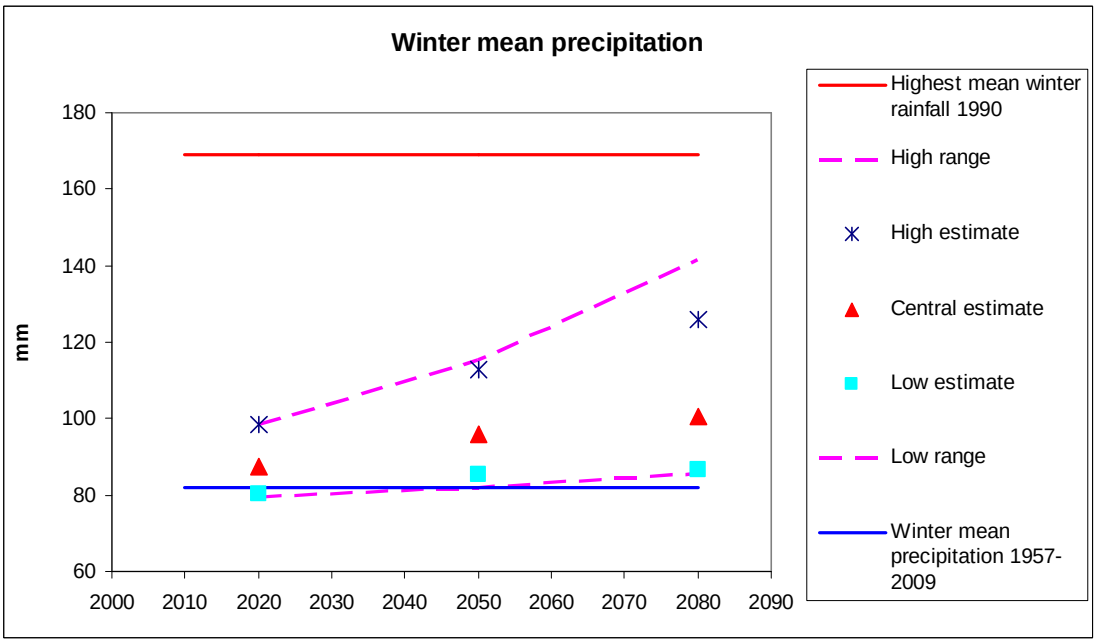
The predictions for summer mean daily maximum temperature show that we will experience temperatures that are significantly higher than the average. However both our highest average daily temperature for a single month and highest recorded summer mean daily temperature recorded in 1995 fall within the expected range of future predictions showing that we have managed to deal with these conditions in the past. The average summer mean daily temperature falls outside of the range of predicted values indicating that we do not experience these conditions on a regular basis. In future we need to plan for more frequent periods of high summer temperature and the impacts associated with these conditions.

1.7.3. Annual mean precipitation



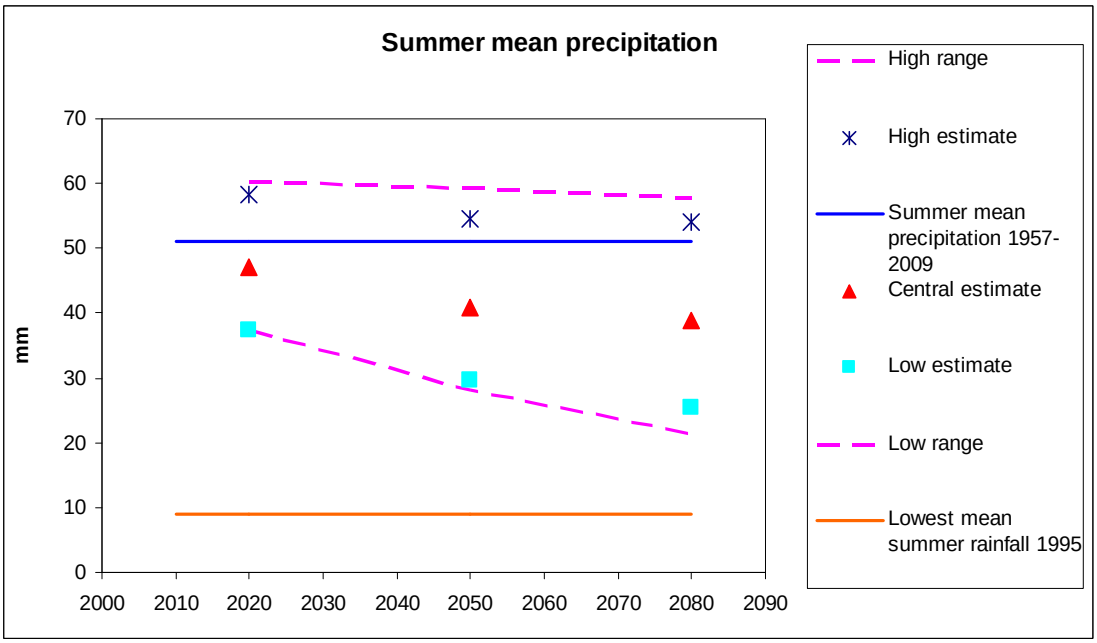
Annual mean precipitation does not show a significant deviation from what we currently experience. From the above figure we note that the range of mean annual precipitation experienced in the past is far wider than that predicted in the UKCIP 09 scenarios. Predicted mean annual precipitation will not have a marked impact on the company and the carrying out of our functions. However we do note that the nature and intensity of the rainfall events will change. This is something that will be monitored, as high intensity rainfall events could pose potential impacts with regard to surface flooding.

1.7.4. Winter mean precipitation



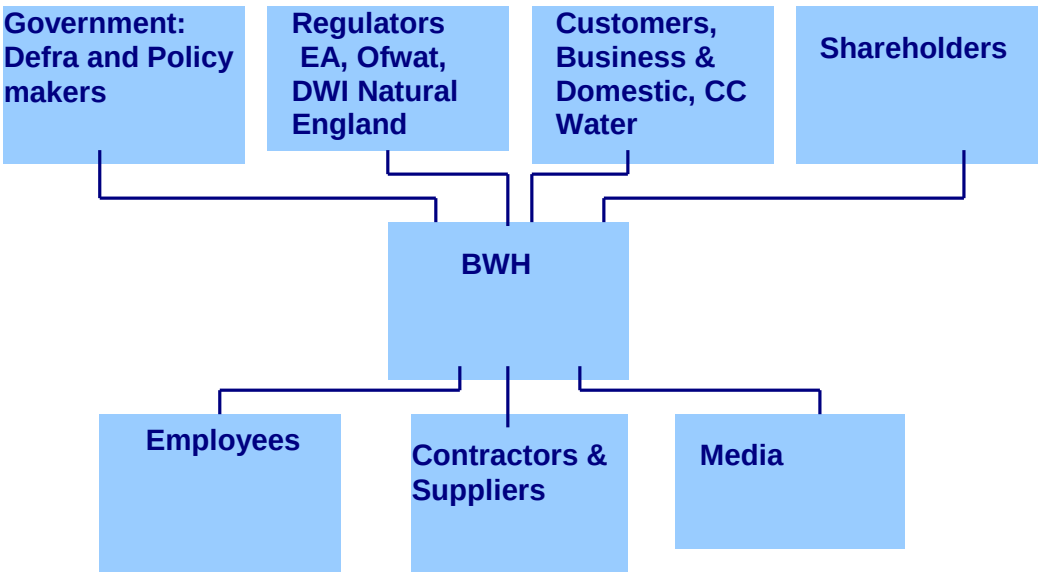
Winter mean precipitation is predicted to be higher than our current mean winter precipitation. The increase in winter precipitation provides a benefit to the company in that it allows for greater groundwater recharge. Our highest recorded mean winter rainfall is significantly higher than the highest estimated future value indicating that we have capacity to deal with the predicted conditions at present. We will continue to monitor the impacts of increased winter precipitation on areas of operation with particular emphasis on the impacts on surface flooding.

1.7.5. Summer mean precipitation



Summer mean precipitation is predicted to be lower than current average summer precipitation. Our lowest recorded mean summer rainfall occurred in 1995 and is significantly lower than the lowest predicted future summer rainfall scenario. Mean summer rainfall is a factor in all water resource and business planning and therefore the effects are monitored and updated as part of regular business planning.

1.8. Key stakeholders



Defra is the UK government department responsible for policy and regulations on the environment, food and rural affairs. Defra's Structural Reform Plan (SRP) lays down three departmental priorities, one of which is to "support a strong and sustainable green economy, resilient to climate change". Defra is responsible for publishing the statutory guidance to reporting authorities[10]

Ofwat is the water industry economic regulator responsible for setting an upper limit on the price that each regulated water and sewerage company can charge its customers. Ofwat protects the interests of water company customers by incentivising efficiency and high service standards and penalising inefficiency and poor service. Price limits are set through the price review (PR) process. The price review is a financial review process whereby Ofwat determines the price limits that water companies can increase or decrease the prices charged to customers over the next 5 year period.

Each water company submits a Business Plan (BP) for the period of the review which is assessed by Ofwat. These price limits are set to enable water companies to deliver the services required of them over a five year period. These include allowing for capital maintenance of assets, ensuring security of supply and meeting drinking water and environmental quality standards and requirements. The price limits for 2010 to 2015 were set in 2009**.**

The Environment Agency is a non-departmental arm of DEFRA put in place to protect or enhance the environment and promote the objective of achieving sustainable development. Their remit covers the whole of England and Wales. The Environment Agency monitors all raw water abstractions and company environmental performance.

[10] Defra, "Adapting to Climate Change: helping key sectors to adapt to climate change", 2009

The *Drinking Water Inspectorate DWI* ensures that the water companies in England and Wales supply safe drinking water that is acceptable to consumers and meets the standards set down in law.

Natural England ensures sustainable stewardship of the land and sea. They work with farmers and land managers; business and industry; planners and developers; national, regional and local government; interest groups and local communities to help them improve their local environment. Natural England oversees the management of sites designated for nature conservation and ensures the company meets its obligation to conserve and improve biodiversity.

We have various other key stakeholders, including local authorities, contractors, suppliers, local community groups, business and domestic customers.

The direct impacts of climate change on our key stakeholders are mostly out of our control. Certain suppliers such as those providing energy are essential public services and therefore should have adaptation plans in place themselves. We informed all our stakeholders about the company's plans and objectives for the next 25 years in our Strategic Direction Statement.

Climate Change Adaptation Plan

Part 2

Company approach

Part 2 Index

2. Approach climate change adaptation

2.1. Introduction

Our methodology for evaluating the impacts of climate change on our business broadly follows that prescribed in the decision making matrix found in the UKCIP technical report (figure 2.1) This framework will be applied in some form for all assessment of climate change risk across the company.

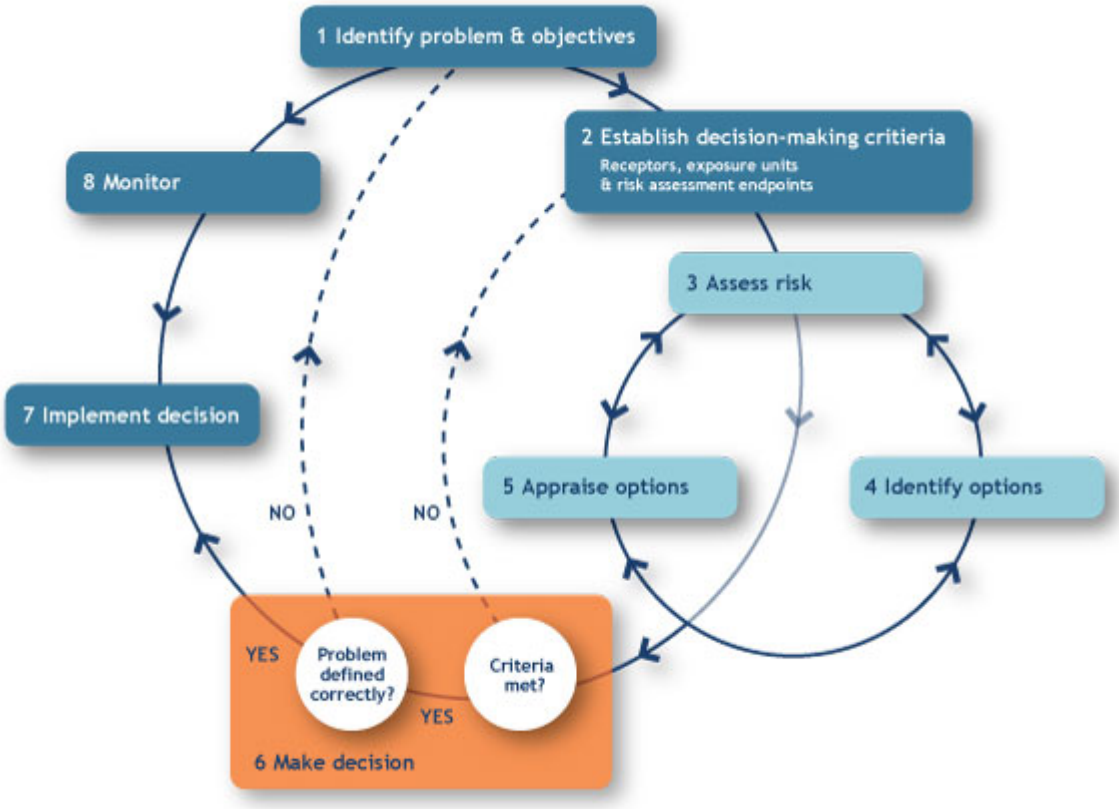


Figure 2.1: Decision making framework[11]

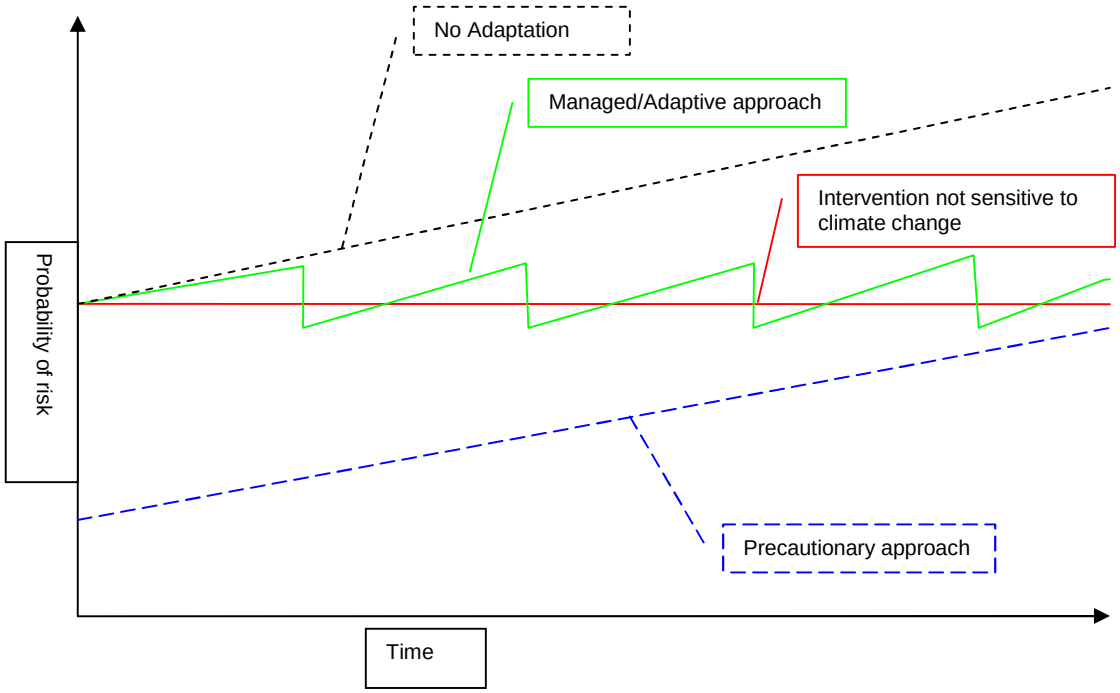
2.1.1. Company approach to managing risk and climate change adaptation

The Climate Change Adaptation report is structured so that any changes in assumptions and plans can be added in the future. The company adaptation plan will be monitored and updated on an annual basis. Climate change is already taken into account in our long term planning for water resources and asset management. This plan will ensure that climate change becomes embedded in all future decision making. It will also ensure that the same set of criteria is used when assessing future climate change impacts on any one area of operation. Responding to the impacts of climate change requires us to adopt one of two approaches to risk: namely the Precautionary approach or

[11] Climate adaptation: Risk, uncertainty and decision-making UKCIP Technical Report

the Managed adaptive approach: (see chart 2.1.1) Climate change risks are just one of many faced by the company. As with all risks we have controls in place to deal with these risks. Through the process of our business planning all risks to carrying out our operations are considered. In the event that we identify a new threat to the company this and the associated controls are included on the company risk register or Water Safety Plan.

Chart 2.1.1 Risk management approaches [12]



2.1.2. The Precautionary approach

The precautionary approach is adopted when future adaptation may be technically unfeasible or too complex to administer over the long term. This approach is taken when planning for long life assets such as underground infrastructure. These assets are going to be in the ground up to and over 100 years and therefore multiple interventions to manage future risk are not feasible.

2.1.3. The Managed adaptive approach

The managed adaptive approach tracks the risk over time and allows for risk to be managed through multiple interventions over time. Large capital schemes require good data and need a high level of confidence that the solution will be successful and efficient use of money. By following a managed adaptive approach we can approach investment in smaller incremental steps thereby reducing the risk of using resources in an inefficient manner. All water companies are expected to manage both above and below ground assets through the five year Asset Management Plan (AMP) periods. This gives us a window of opportunity every five years to assess climate risks as these and

[12]Flood and Coastal Defence Appraisal Guidance FCDPAG3 Economic Appraisal Supplementary Note to Operating Authorities – Climate Change Impacts October 2006

their consequences become better known. This will provide an ideal opportunity to adapt our systems, procedures and infrastructure to be resilient to future change.

2.2. Evidence methods and expertise used to evaluate climate change impacts

For the purpose of this report we have limited our analysis to a high level. Climate change risks and hazards have been assessed and identified by following the Water UK study, A Climate Change Adaptation Approach for Asset Management (2007)[13]. These impacts have been analysed with reference to the UKCIP09 scenarios by relevant experts across all areas of the business. References to the material used in compiling the list of impacts are provided in Appendix 4.

2.2.1. Evidence

To determine the future climatic conditions we have used the UKCIP scenarios described in section Appendix 1 of this report. The Water UK study[14] provides water companies with a list of environmental risks and associated consequences that will arise as a result of changing climatic conditions.

2.2.2. Methods and expertise

Where possible we have followed the UKCIP decision making framework when evaluating the impacts of climate change on our business. Our qualitative risk assessment has been carried out by relevant experts across the company. This was done by evaluating the impacts identified in the Water UK study in terms of the UKCIP 09 climate projections. The highest scoring impacts on the companies various assets and the associated hazards were then cross referenced to company publications listed in table 2.2.2. This was done to ensure that the hazards identified in the risk assessment have been taken into account. These hazards and consequences are either dealt with in regulatory planning such as the Water Resource Management Plan, Drought Plan and Asset Management Plan or in strategic documents such as the company risk register and Water Safety Plans.

[13] Water UK A Climate Change Adaptation Approach for Asset Management Planning 41414874 V1.0

[14] Water UK A Climate Change Adaptation Approach for Asset Management Planning 41414874 V1.0

Table 2.2.2

Division of assets [15]	Asset at risk	Company Reference documents
Water resources	Storage Reservoirs	Final water Resource Plan 2009, PR09 Business Plan 2009, Water Safety Plan, Company Risk Register, Drought Plan 2007
	Boreholes/Source pumping stations	Final water Resource Plan 2009, PR09 Business Plan 2009, Water Safety Plan, Company Risk Register, Drought Plan 2007
	Raw water pipelines	Final water Resource Plan 2009, PR09 Business Plan 2009, Water Safety Plan, Company Risk Register
	Intake pumping stations	Final water Resource Plan 2009, PR09 Business Plan 2009, Water Safety Plan, Company Risk Register
Water treatment	Treatment works	Final water Resource Plan 2009, PR09 Business Plan 2009, Water Safety Plan, Company Risk Register
	Service reservoirs and Water Towers	Final water Resource Plan 2009, PR09 Business Plan 2009, Water Safety Plan, Company Risk Register
	Treated water pipelines	Final water Resource Plan 2009, PR09 Business Plan 2009, Water Safety Plan, Company Risk Register
	Treated water pumping stations	Final water Resource Plan 2009, PR09 Business Plan 2009, Water Safety Plan Company Risk Register
Water Networks	Distribution networks including ancillaries	Final water Resource Plan 2009, PR09 Business Plan 2009, Water Safety Plan, Company Risk Register
	Distribution pumping stations	Final water Resource Plan 2009, PR09 Business Plan 2009, Water Safety Plan, Company Risk Register
	Distribution Storage	Final water Resource Plan 2009, PR09 Business Plan 2009, Water Safety Plan, Company Risk Register
Site Wide Services	SCADA and Telemetry	PR09 Business Plan 2009, Company Risk Register
	Electrical supply	PR09 Business Plan 2009, Company Risk Register
	Buildings	PR09 Business Plan 2009, Company Risk Register
	Security	PR09 Business Plan 2009, Company Risk Register
	Mobile plant	PR09 Business Plan 2009, Company Risk Register

[15] Water UK A Climate Change Adaptation Approach for Asset Management Planning 41414874 V1.0

2.3. Quantifying and assessment of risk

This report covers potential impacts for the time periods 2020's 2050's and 2080's with the greatest emphasis and certainty around those impacts identified for the 2020's. This ensures that we are consistent with our Water Resources Management Plan and Company Strategic Direction Statement which is the company strategy for the next 25 years.

The Water UK study provides a common approach for assessing climate change adaptation risks and allows these to be incorporated into asset management planning. For water only companies such as Bournemouth & West Hampshire Water the study identifies how droughts, temperature rise, flooding and sea level rise affect the company assets

As it has been pointed out the company aims to maintain or improve our levels of service. Our risk assessment takes into account the consequences for service in combination with the likelihood of that consequence occurring in the future. We apply this to all the impacts identified in the Water UK study which encompass all areas of operation across the company.

2.3.1. Levels of Consequence

We have based our risk assessment on the corporate risk assessment structure used in all areas across the business. Relevant experts across the company used the matrix found in table 2.3.1 to score all the climate change impacts that were highlighted in the Water UK study.

Table 2.3.1 Likelihood score

HARM ASSETS/SERVICES	REPUTATION	INTERNAL	DAMAGE	LOSS	SCORE
Minor damage, extra repairs or maintenance	-No impact on reputation	-Short run loss of a business system	-Minor -Few customer complaints	-Minor -£10K to £40K -Loss of supply to <1K customers	**1**
Minor deterioration in assets	-Minor local press release (one local paper)	-Short run loss of supply		-Loss of supply to 1K to 2K customers	**2**
Deterioration of assets requiring substantial maintenance/replacement, change to investment plan	-Broad local press coverage (Most local papers & radio)	-Long run Loss of IT\Comms - Fire in principle building Major overheads for staff	-Major -Multiple customer complaints	-Major -£40K to £100K -Loss of supply to 2K to 5K customers	**3**
Major maintenance/replacement of assets, reduction of Security of supply	-National press coverage -Local TV coverage	-Unable to control business system -Long run loss of business system		-Loss of supply to 5K to 10K customers -National press coverage	**4**
Failure of service/asset	-Long term loss of reputation	-Unable to control water supply -Long run loss of water supply	-Catastrophic - Undefendable prosecution	-Catastrophic -£100K + -Loss of supply to 10K+ customers -Loss of BWHW reputation	**5**

2.3.2. Likelihood score

The likelihood of the company being affected by the various climate change impacts identified in the Water UK study are determined by assessing the most likely future climate scenarios and using expert judgement to determine the probability of the predicted conditions affecting the various areas of operation for each time period.

Table 2.3.2

Likelihood	Description	Score
Extremely unlikely	Almost no chance of occurring during the timeframe	**1**
Unlikely	Low probability will occur during the timeframe	**2**
Possible	Medium probability will occur in the timeframe	**3**
Likely	High probability will occur in the timeframe	**4**
Almost certain	Almost certain to occur in the timeframe	**5**

2.3.3. Risk Score

Impacts are scored and classified using table 2.3.3 below. Risk score = Level of consequence x Likelihood. The highest scoring risks are analysed in further detail in part 3 of this plan.

Table 2.3.3 Risk Scores

Risk	Score
High Risk	15-25
Medium Risk	8-14
Low Risk	1-7

2.3.4. Confidence in assessment

The level of confidence in our assessment of risk reflects the type of analysis undertaken and the confidence in the predicted future climate conditions.

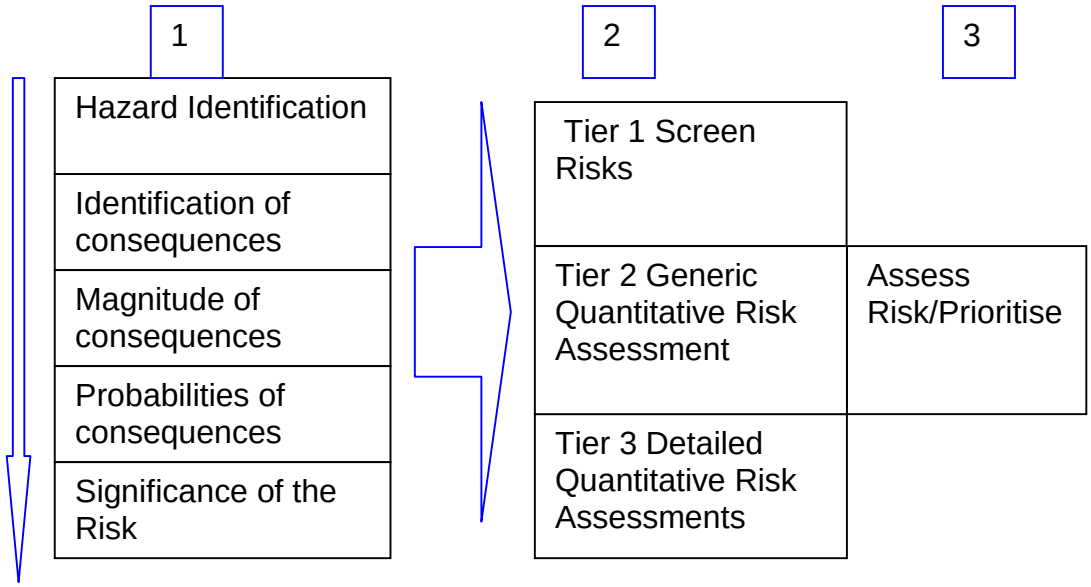
Table 2.3.4 Confidence

Confidence in assessment	Analysis	Attributes
High	Quantitative	Experienced similar conditions in the past. High degree of certainty in predicted future conditions
Medium	Expert qualitative	Experienced similar conditions in the past. Medium level of certainty in predicted future conditions
Low	Best estimate qualitative	Conditions fall outside of those experienced in the past. Low level of certainty in predicted future conditions

2.3.5. Risk assessment methodology

In compiling the risk assessment for the climate change adaptation plan we followed the methodology in the Climate adaptation: Risk, uncertainty and decision-making UKCIP Technical Report.

3 tier risk assessment[16]



The three tier process [17]

Tier 1 – a systematic qualitative analysis, where the size, significance and relative importance of the risks, costs and benefits for each option are described. This has been done using the company 5 x 5 risk assessment matrixes and by utilising expert judgement. All risks identified in the Water UK study that are relevant to the company are initially assessed in this manner. All impacts from the study were analysed by relevant experts across the company, these were given likelihood and consequence scores for each timeframe 2020's, 2050's and 2080's.

Tier 2 – a semi-quantitative analysis. All the highest scoring impacts for each timeframe identified under tier 1 have been stripped out and analysed further. We have used expert judgement to assess these risks. However in following this methodology future iterations of our adaptation plan will seek to assign qualitative data to this assessment.

Tier 3 – a fully quantitative analysis, where the probable performance of each option in managing the risk is quantified in terms of costs and benefits and, in some cases or where possible converted into monetary terms. It is very

[16] Climate adaptation: Risk, uncertainty and decision-making UKCIP Technical Report
[17] Climate adaptation: Risk, uncertainty and decision-making UKCIP Technical Report

unlikely that the company can carry out an assessment to this level at present due to lack of data and the high level of uncertainty around the climate change predictions. Added to this at present we not identified any additional high risk, high consequence impacts that have not been evaluated in our planning for the next 25 years.

2.4. Evaluation of the costs and benefits of the proposed adaptation options

In our climate change impact assessment we have not identified any additional risks that have not been covered in our strategic business planning. Therefore we have no need for immediate investment for adaptation outside of a small number of schemes already programmed in for the next AMP (asset management period). The company risk register and water safety plans already hold a complete breakdown of all company risks and the controls in place to deal with these. We have linked the hazards from the highest scoring climate change impacts to those found in the company risk register and water safety plan where possible. In future, when reviewing the climate change risk assessment, if we identify hazards that are not covered in our corporate risk assessments; these will be flagged up and added.

Climate Change Adaptation Plan
Part 3
Summary of risks which affect functions, mission aims and objectives

Part 3 Index

3.4. Opportunities as a result of climate change

3.4.1. Higher winter rainfall

3.4.2. More resilient infrastructure

3. Summary of risks which affect functions, mission aims and objectives

Climate change risks are one of many that face the company. We need to be proactive when dealing with all risks to the company and particularly when dealing with those that relate to climate change. The risk assessment for the purpose of this report has been at a high level to enable us to identify the areas that we need to focus on with regards to climatic impacts. In future iterations of the Climate Change Adaptation Plan (CCA), climate change risks will be analysed in more detail to ensure that we maintain our ability to cope with and adapt to future climatic conditions.

3.1. Strategic risks faced by the organisation

In Appendix 2 we list all the climate change impacts identified in the Water UK study. It was evident from the analysis of these risks that the most common risks facing the company were related to higher demands, reduced yields temperature increases and surface flooding.

3.2. Short and long term Impacts of climate change

The assessment of risks for the purpose of this report has made use of the three timeframes provided in the UKCIP09 scenarios 2020's, 2050's and 2080's. The highest scoring risks for each timeframe with the associated likelihood and confidence score are listed in Appendix 3.

3.2.1. 2020's Medium term risk

In the medium term we refer to our Strategic Direction Statement (SDS), Water Resource Management Plan, Drought Plan and our 2009 Periodic Review. We have not identified any risks to the company that have not been addressed in one of the before mentioned planning documents.

3.2.2. 2050's Long term risk

All climate change risks will be reassessed in more detail in the next round of Business Plans and Water Resources Plans. In the interim climate risks will be monitored and updated when necessary in the annual review of the Climate Change Adaptation Plan.

3.2.3. 2080's Very long term risk

There is a high degree of uncertainty surrounding the magnitude of the climate change impacts for this timeframe. We see higher risk scores for climatic impacts during this timeframe; this is down to increased possibility of the risks occurring.

3.3. High priority climate related risks

From our analysis of the timeframes 2020's, 2050's and 2080's we have selected the highest scoring climate change impacts faced by the company (table 3.3).

These have been analysed and displayed on a likelihood consequence matrix for the time periods 2020, 2050 and 2080.

A detailed description of each impact follows the table below. Each top priority risk has a number of potential hazards to the company; these and the control mechanism to mitigate each hazard are provided in the company risk register and Water Safety Plan (WSP).

The relevant risk register and WSP risk assessments for each of the highest scoring climate change risks are supplied under each impact description where applicable. We have not undertaken an analysis of costs for the purpose of this report. In future reviews this will be an option.

Our level of confidence in our estimations reduces moving into the future. This is due to the huge amount of uncertainty in the future climate scenarios. Confidence assessments for the top climate change impacts are provided for the highest priority impacts.

As a result of this report, climate change impacts have been added to the company risk register and will now assume part of our business as usual risk management practices.

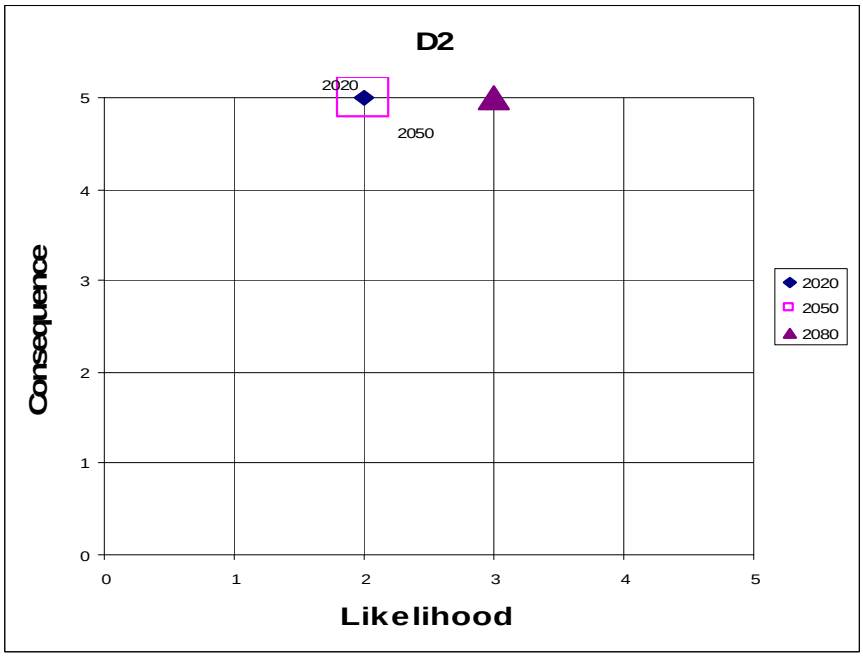
Table 3.3 Top scoring climate change impacts

The risks listed in the table below represent those that had the highest score after the qualitative risk assessment. The qualitative risk assessment has been based on the Water UK study, A Climate Change Adaptation Approach for Asset Management (2007)[18] . These are explained in more detail in the following section.

No	ASSET LEVEL 2	ASSET IMPACTED	REF.	IMPACT TYPE	PRESSURE	CONSEQUENCE FOR ASSETS & OPERATIONS	CONSEQUENCE FOR SERVICE
3.3.1	WATER RESOURCES	All Water Resources	D2	DROUGHT	Higher daily & peak demand for garden watering,	lower security of supply	Reduction in levels of service
3.3.2	WATER RESOURCES	All Water Resources	D4	DROUGHT	Lower river & borehole yields or reduced water quality,	abstraction licences reduced or removed, reducing security of supply	Reduction in levels of service
3.3.3	WATER TREATMENT	All Water Treatment	T10	TEMP. RISE	Higher temperatures	more algal growth and micro-organisms in the water supply system	higher drinking water quality risk
3.3.4	WATER TREATMENT	Treatment works	T12	TEMP. RISE	Higher temperatures	lower raw water quality	greater risk to drinking water quality
3.3.5	WATER NETWORKS	Distribution networks incl. ancillaries	T20	TEMP. RISE	More extreme wetting and drying cycles	greater soil movement, more pipe movement and bursts	Reduction in levels of service
3.3.6	SITE-WIDE SERVICES	All Site wide Services	T57	TEMP. RISE	Higher average and peak temperatures	accelerated deterioration of structures, buildings, machinery, equipment	Reduction in levels of service
3.3.7	WATER RESOURCES	All Water Resources	F1	FLOOD	Direct asset flooding	asset loss	service failure
3.3.8	WATER TREATMENT	All Water Treatment	F11	FLOOD	Direct asset flooding	asset loss	service failure
3.3.9	WATER NETWORKS	All Water Networks	F17	FLOOD	Direct asset flooding	asset loss	service failure
3.3.10	WATER RESOURCES	All Water Resources	S1	SEA LEVEL	Direct asset flooding, storm damage, coastal erosion or planned retreat	asset loss	service failure
3.3.11	WATER RESOURCES	All Water Resources	S2	SEA LEVEL	Saline intrusion	accelerated asset deterioration	Service failure/ reduction

[18] Water UK A Climate Change Adaptation Approach for Asset Management Planning 41414874 V1.0

3.3.1. Impact D2 Higher daily and peak demand for garden watering as a result of drought



This represents a high consequence low probability risk to the company if daily peak demand was greater than our ability to supply water it could lead to service failures thus lowering our security of supply.

In the past our system has experienced high peak demands during the summer months mainly attributed to garden watering and large numbers of summer visitors. We have a residential profile that is dominated by the most affluent socio-demographic groups, giving rise to a high number of detached households with gardens[19]. The estimated number of visitors during the peak months of July and August has been estimated at 50 000. This number excludes day-trippers and is equivalent to 12% of the usual residential population. Our Water Resources Plan (WRP)[20] focuses on managing this demand during peak periods. These plans project 25 years into the future and are reviewed each year with a new plan submitted every 5 years. This means that we are constantly forecasting 25 years ahead of where we are at present ensuring that we proactively deal with changes in demand as climatic conditions change and knowledge of future conditions improves. We will use the latest UKCIP projections when compiling our next WRP.

Our current WRP does not foresee any need to develop any new resources to deal with peak summer demands during in the next 25 years. We continue to manage demand through a programme of metering, targeted water efficiency activity and a continued focus on leakage control. We continue to monitor trends in peak summer demand and use the latest population data when

[19] Bournemouth & West Hampshire Water, Drought Plan October 2007
[20] Bournemouth & West Hampshire Water, Water Resources Management Plan Nov 2009

compiling our forecasts. As can be seen in the chart below we have experience a year on year reduction in demand since 2004.

As a result of statutory long term planning it is extremely unlikely that a situation would arise where supply outstrips demand as this would be identified in future forecasts and measures put in place to deal with the situation before it arises.
As can be seen from the chart above the likelihood of the impact D2 occurring does increase when we move beyond 2050. This is due to the huge amount of uncertainty around the predicted climatic conditions that we are going to experience during this timeframe.

Chart 3.3.1 BWH *Monthly demand profile* 2005-2010[21]

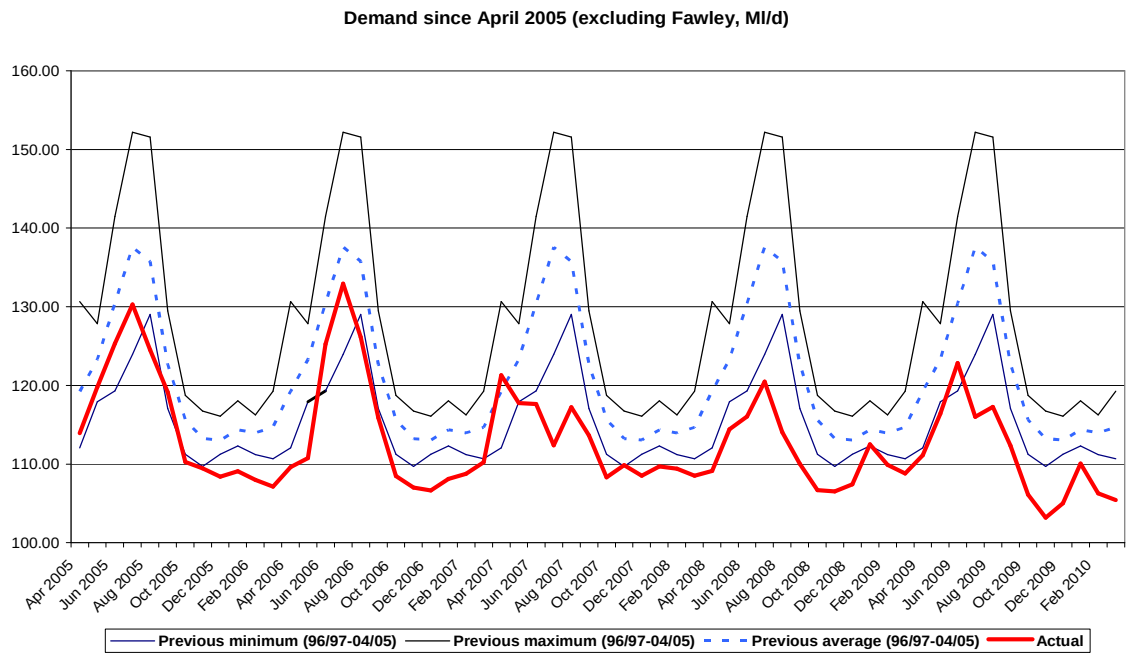


Table 3.3.1 A Relevant risk assessments from BWH risk register

Risk register ID	Description
15	Supply demand balance deficit
20	Service levels not met
89	Drought
213	DG3 Failure interruptions to supply
216	Increased customer base
226	Water resources planning, long term management of supply demand balance
73	Long run loss of source (River/Borehole)

Table 3.3.1 B Relevant risk assessments from BWH Water Safety Plan (WSP)

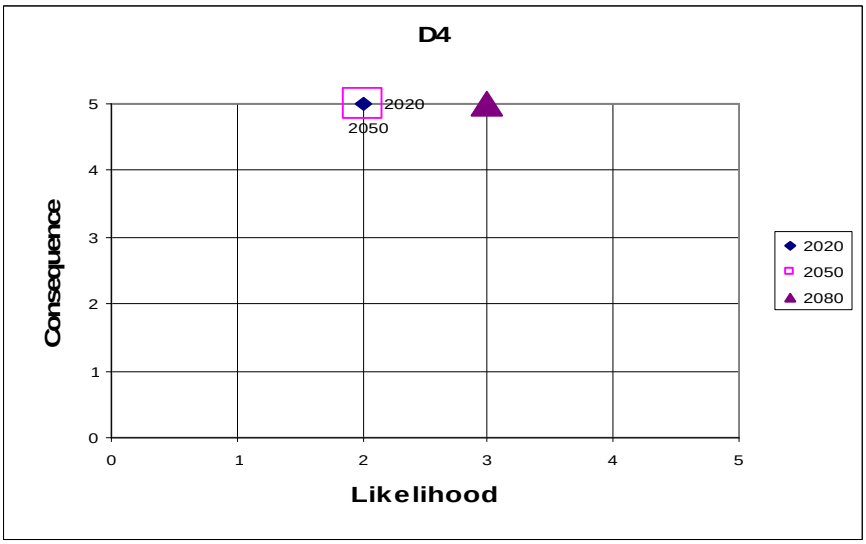
WSP ID*	Hazardous event	Hazard
RA-RES-5	Reservoir empties	System depressurisation/dirty water ingress
RA-RES-7	Insufficient capacity to cope with high demand (bursts etc.)	Reservoir empties
RA-RES-3	Poor water turn over	Poor water quality

[21] Bournemouth & West Hampshire Water June Return 2010 Table 10b

*****WSP id for impacts on storage reservoirs (RES) are common for all our reservoirs.

Level of confidence in assessment	Comments
Medium	Data in WRP, Drought plan and FBP

3.3.2. Impact D4 Lower river & borehole yields or reduced water quality arising as a result of drought



We operate a number of sources of water, as shown in table below. In dry conditions, the available capacity of each source is determined by river flow, groundwater level, abstraction licence or treatment capacity, and is known as the deployable output. In planning terms, we also need to account for plant availability constraints, such as system failures or source pollution. The deployable output figures in the table have therefore been adjusted to show the estimated water available for use in dry weather conditions, on average and in the week of peak demand. These were derived using guidance provided by the Environment Agency (EA).

It is customary in planning for the long term to incorporate an allowance for uncertainty – in water resources planning this allowance is called headroom. Headroom is defined as *the minimum buffer that a prudent water company should allow between supply and demand to cater for specified uncertainties in the supply demand balance.* In compiling the supply demand balance, the headroom allowance is added to the demand forecast, and the resulting total is compared against the available supply. On the whole the water available for use (WAFU) for the company does not change over the WRP period with no anticipated deficits in either the dry year or critical period scenario (up to 2034/35).

Beyond the planning scenario the likelihood of experiencing a drop in available resource does increase slightly, this is due to the increased uncertainty. The nature of our sources means that we are reliant on their instantaneous performance; however we have developed bankside storage to deal with peak demand and have the option to develop further storage in future.

All our sources are partially or wholly reliant on groundwater, this is an advantage to the company as the chalk aquifer that feeds these acts as a reservoir which recharges over the winter. Future scenarios tend to show that winter rainfall is to increase thus putting our sources in an even more robust position. Further to this we have also seen a reduction in peak demand over the past few years (see chart 3.3.1) which can be partially attributed to increasing customer awareness of water resource issues and changing customer behaviour. We are monitoring these trends closely to gain a greater understanding of the drivers of these changes and if they will be permanent.

In the company Water Resources Management Plan (WRMP) we have analysed the effects of climate change on both our surface and groundwater resources.

Surface water

This was done following the Draft Protocol Guidance (ref NWA/NSR v5) which was provided with the WRMP guidelines for surface water.

The long-term flow series for both the River Avon and River Stour have been derived for the WRMP using a methodology based on that developed in the UKWIR CL04 surface water reports[22][23]. Both sources are license constrained and for all sources it was concluded that, at the time of analysis using the UKCIP climate change scenarios there was no need to allow for climate change impacts on water availability.

Groundwater

The UKWIR critical period groundwater yield methodology[24] for groundwater yields was used to determine the effects of the UKCIP 2020's medium emissions scenarios on aquifer levels.

It was concluded that there was likely to be no impact on our groundwater sources deployable output (DO) during the WRMP planning horizon.

This conclusions for both surface and groundwater sources are to be kept under review over the course of AMP 5 and in the light of any new research or any new regulatory guidance.

[22] Effects of climate change on river flows and groundwater recharge: guidelines for resource assessment and UKWIR06 scenarios (UKWIR Report CL04, 2007)
[23] Effects of climate change on river flows and groundwater recharge: a practical methodology for draft recharge and groundwater level impact assessment (UKWIR Report CL04, 2007)
[24] Critical period groundwater yield (UKWIR report 02/WR/23/1, 2001)

Table 3.3.2.A

Summary of deployable outputs (Ml/d)[25]		
Source name	*Deployable output*	
	Average	*Peak*
Bournemouth WRZ		
Longham	42.4	51.9
Stanbridge Mill]	12.5	12.5
Knapp Mill	82.7	103.4
Matchams	60.6	60.2
Ampress]	2.4	2.7
Wimborne]	3.9	3.9
Sub-total	204.5	234.6
Hale WRZ		
Woodgreen	12.4	17.5
Company total		
	216.9	**252.0**

Table 3.3.2 B Relevant risk assessments from BWH risk register

Risk register ID	Hazard
15	Supply demand balance deficit
20	Service levels not met
89	Drought
213	DG3 Failure interruptions to supply
216	Increased customer base
226	Water resources planning, long term management of supply demand balance
73	Long run loss of source (River/Borehole)

[25] Bournemouth & West Hampshire Water, Water Resources Management Plan Nov 2009

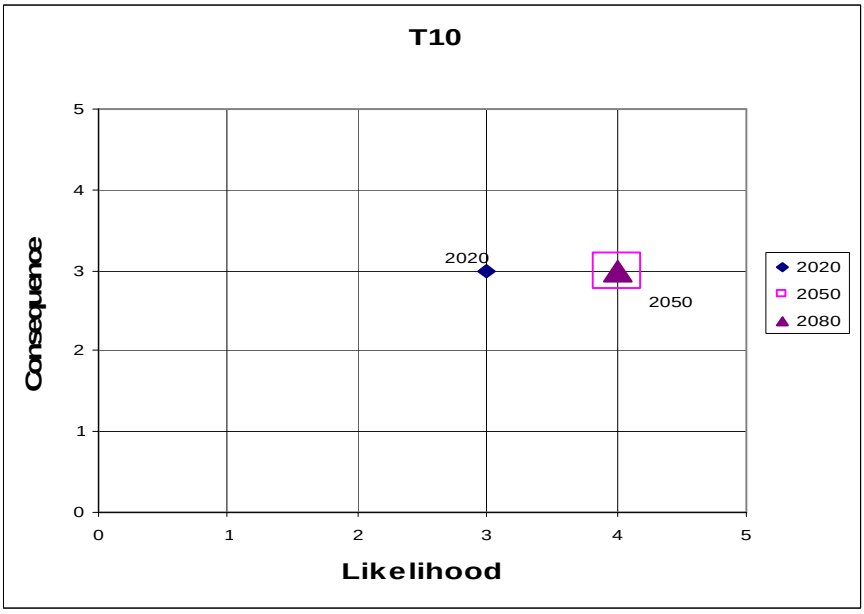
Table 3.3.2 C Relevant risk assessments from BWH Water Safety Plan (WSP)

WSP ID*	Hazardous event	Hazard
RA-WOOD-1	Source vulnerability	High contamination loadings
RA-WOOD-2	Animal loading	High faecal loading
RA-WOOD-13	Natural organic contaminants	Contamination
RA-WOOD-14	Natural inorganic contaminants	Contamination
RA-WOOD-15	Natural microbiological contaminants	Contamination
RA-WOOD-18	Drought	Effects of drought
RA-WOOD-23	Treatment appropriate for source	Poor water quality / contamination
RA-WOOD-24	Poor raw water conditions / Polluted raw water	Over run treatment capability
RA-WOOD-25	Aesthetic parameters	Taste / odour contamination
RA-WOOD-43	Microfiltration failure	Inadequate filtration / breakthrough
RA-STAN-1	Source vulnerability	High contamination loadings
RA-STAN-2	Animal loading	High faecal loading
RA-STAN-18	Drought	Effects of drought
RA-STAN-24	Poor raw water conditions / Polluted raw water	Over run treatment capability
RA-STAN-25	Aesthetic parameters	Taste / odour contamination
RA-KMA-1	Source vulnerability	High contamination loadings
RA-KMA-2	Animal loading	High faecal loading
RA-KMA-18	Drought	Effects of drought
RA-AMP-1	Source vulnerability	High contamination loadings
RA-AMP-2	Animal loading	High faecal loading
RA-AMP-18	Drought	Effects of drought
RA-AMP-23	Treatment appropriate for source	Poor water quality / contamination
RA-AMP-24	Poor raw water conditions / Polluted raw water	Over run treatment capability
RA-AMP-25	Aesthetic parameters	Taste / odour contamination
RA-ALD-1	Source vulnerability	High contamination loadings
RA-ALD-2	Animal loading	High faecal loading
RA-ALD-19	Drought	Effects of drought
RA-ALD-27	Poor raw water conditions / Polluted raw water	Over run treatment capability
RA-RES-1	Ingress of debris/dirty water	Water contamination
RA-RES-5	Reservoir empties	System depressurisation/dirty water ingress
RA-RES-7	Insufficient capacity to cope with high demand (bursts etc.)	Reservoir empties
RA-RES-3	Poor water turn over	Poor water quality

*****WSP id for impacts on storage reservoirs (RES) are common for all our reservoirs.

Level of confidence in assessment	Comments
Medium	Data in WRP, Drought plan and FBP

3.3.3. Impact T10 Increased algal growth and risk of microscopic organisms within the water supply system as a result in increased temperatures



This is not a high consequence risk however it could possibly occur in the short term, with an increasing probability of occurrence as we move into the future. We employ slow sand filters for the treatment of drinking water. Our filter beds are prone to algal build up during times of high temperature with the increasing prevalence of higher summer temperatures in future this could pose a potential problem. Another impact that arises from increased algal growth is the reduction of the capacity of slow sand filters to filter adequate volumes of water due to blinding. This has a potential impact on our ability to supply enough water to meet demands during peak periods.

Table 3.3.3 A. Relevant risk assessments from BWH Water Safety Plan (WSP)

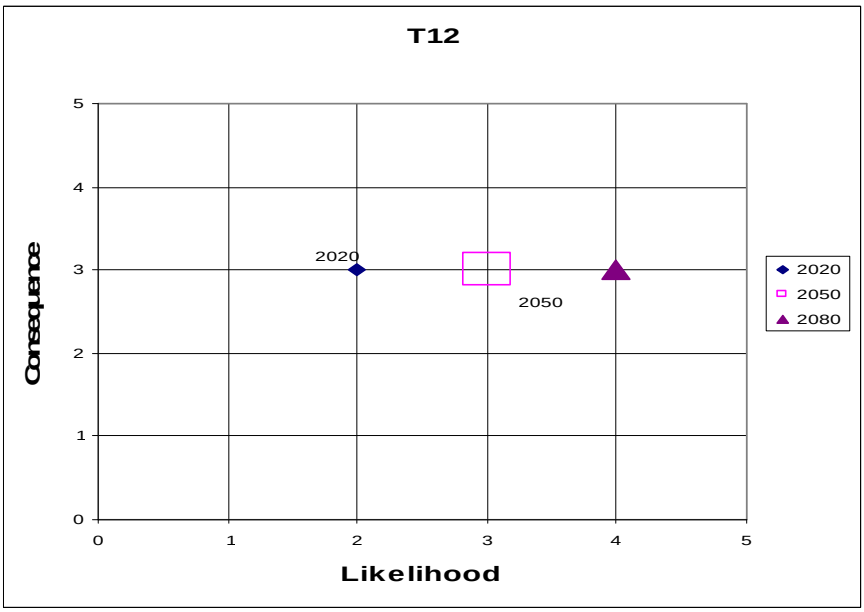
WSP ID	Hazardous event	Hazard
RA-ALD-8	Algal bloom in storage reservoirs	Tastes / toxins
RA-ALD-44	Slow sand filtration failure	Inadequate treatment/breakthrough
RA-KMA-42	Primary filtration failure	Inadequate primary treatment/breakthrough
RA-KMA-43	Slow sand filtration failure	Inadequate treatment/breakthrough

Table 3.3.3 B. Relevant risk assessments from BWH risk register

Risk register ID	Hazard
7	Major water supply failure (quality) resulting in compensation
99	Water quality failure including contamination

Level of confidence in assessment	Comments
Medium,	We have experienced these impacts in the past

3.3.4. Impact T12 Reduced raw water quality as a result of in increased temperatures



Increased peak summer temperatures are a prominent feature of the climate of the future. Higher temperatures will also occur for longer periods of time leading to increased biological activity in raw water. The slow sand filters used in our main treatment works are susceptible to algal blinding during periods of increased temperatures.

Table 3.3.4 A. Relevant risk assessments from BWH Water Safety Plan (WSP)

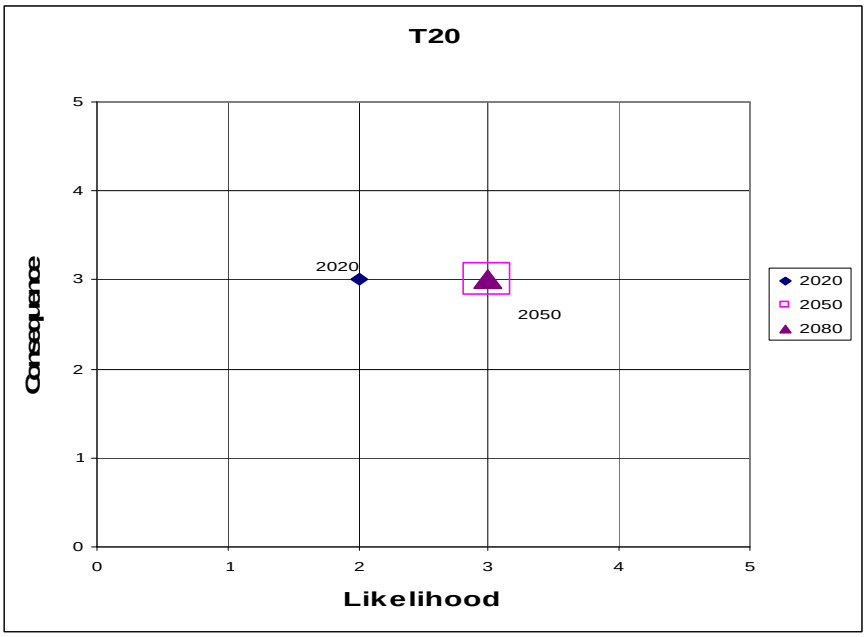
WSP ID	Hazardous event	Hazard
RA-ALD-1	Source vulnerability	High contamination loadings
RA-ALD-8	Algal bloom in storage reservoirs	Tastes / toxins
RA-ALD-14	Natural organic contaminants	Contamination
RA-KMA-18	Drought	Effects of drought
RA-ALD-16	Natural microbiological contaminants	Contamination
RA-ALD-27	Poor raw water conditions / Polluted raw water	Over run treatment capability
RA-ALD-26	Treatment appropriate for source	Poor water quality / contamination
RA-ALD-44	Slow sand filtration failure	Inadequate treatment/breakthrough
RA-KMA-43	Slow sand filtration failure	Inadequate treatment/breakthrough

Table 3.3.4 B. Relevant risk assessments from BWH risk register

Risk register ID	Hazard
7	Major water supply failure (quality) resulting in compensation
99	Water quality failure including contamination

Level of confidence in assessment	Comments
Medium	We have experienced these impacts in the past

3.3.5. Impact T20 more extreme wetting and drying cycles arising as a result of increased summer temperatures



Changes in wetting and drying cycles may have the effect of increasing ground movement in certain soil types. This is of particular concern to our underground network assets causing a higher frequency of bursts. This has the effect of increasing leakage and reducing our levels of service.
As stated in our PR09 business plan[26]we are increasing the rate of mains renewal and associated equipment. Our long term strategy is to move towards a mains renewal rate of approximately 1% of the entire network per annum. This being the level of mains renewal needed to maintain stable serviceability and sustainability of assets over the long term. From analysis work done during the periodic review it was decided that in the medium term mains renewal rates could increase to approximately 0.43% with a view to moving to 1% renewal rate in the future.

Increased ground movement in the future will have an impact on the asset life of underground assets, rendering them shorter and thereby having the effect of increasing the percentage of the network we need to renew in order to achieve stability and serviceability levels desired.

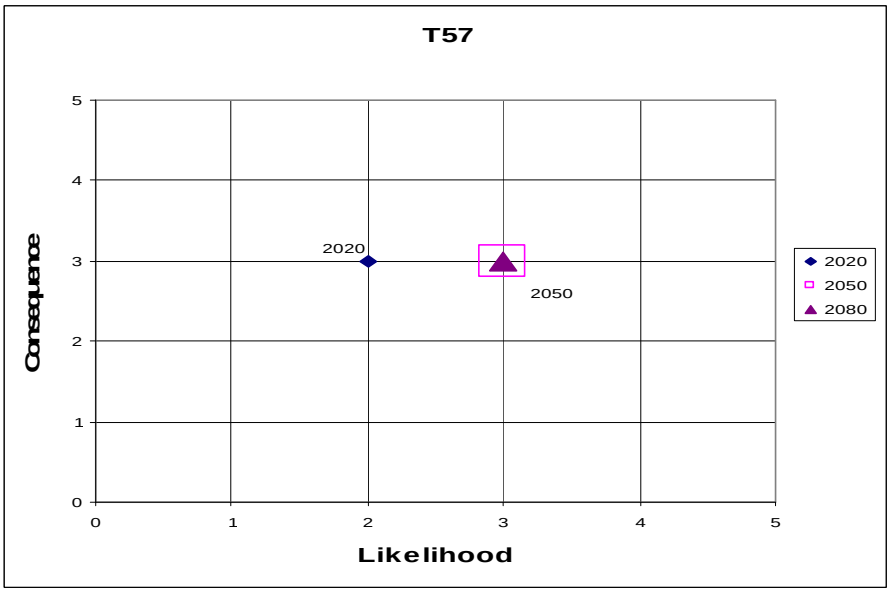
[26] Bournemouth & West Hampshire Water Periodic review 2009-Final business plan

Table 3.3.5 A. Relevant risk assessments from BWH risk register

Risk register ID	Hazard
27	Catastrophic flood of properties
34	Flooding of gas mains
192	Inset/common carriage incorrectly managed contamination/dirty water
200	Uncontrolled damage to other utilities
205	Missing leakage targets
206	Long run loss of trunk mains
210	Environmental contamination by our actions
212	DG2 failure (poor pressure)
213	DG3 failure (interruption to supply)
215	Flooding properties
265	Resources and waste management
286	Third party underground utilities
754	Water flooding the road
756	Mechanical excavator striking a cable
778	Pipe bursting flooding gas mains

Level of confidence in assessment	Comments
Medium	More data and further analysis is needed

3.3.6. Impact T57 Acceleration of the deterioration in structures, buildings and machinery equipment as a result of higher peak and average temperatures



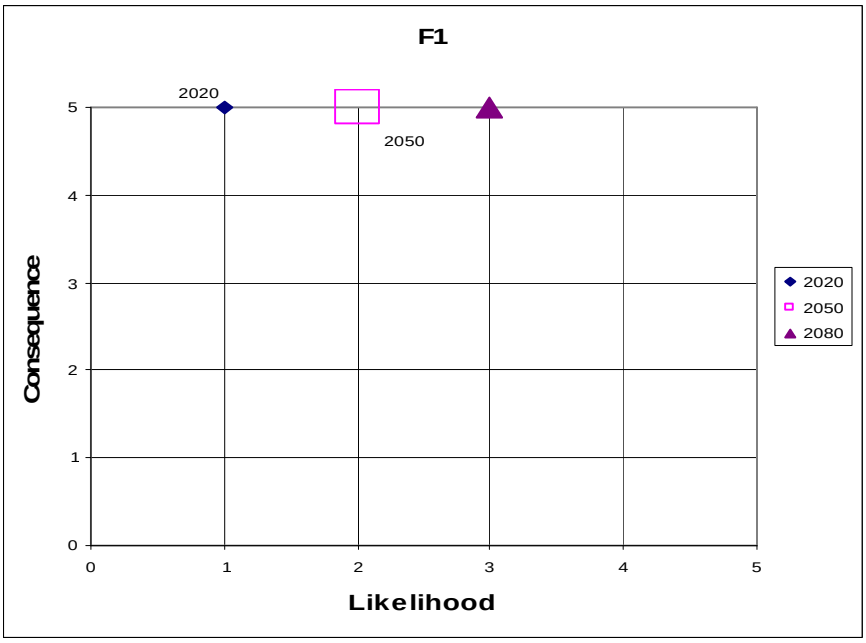
All company assets are designed to cope with current climatic conditions with tolerances built in to cope with extremes. As we move into the future extreme climatic events will become more frequent and prolonged. We need to assess the impact that this will have on our assets. From analysis of past extremes we can see that we have in the past experienced conditions similar to those expected under future climate change scenarios. We are ideally placed to deal with these impacts on our assets through our long term asset management planning. We have no plans for building of any new long life above ground assets in the medium term. As the industry plans in 5 year periods we are provided with the ideal opportunity to adapt our assets over time to cope with changing climatic conditions through refurbishment and replacement of these assets.

Table 3.3.6 A. Relevant risk assessments from BWH risk register

Risk register ID	Hazard
74	Loss of Knapp Mill high lift
75	Loss of Aderney high lift
77	Loss of Longham high lift
81	Loss of Knapp Mill low lift
82	Loss of Aderney low lift
85	Electrical failure (external/internal, lightning)
87	Telemetry failure
94	Loss of primary filtration
95	Loss of sand washing plant
102	Collapse of pipe bridge
251	Major failure of a key pumping station less than 24 hours
252	Major failure of a key pumping station greater than 24 hours
490	Trunk or other main failure taking a long time to repair resulting in a loss of supply to a significant number of properties

Level of confidence in assessment	Comments
Medium	More data and further analysis is needed

3.3.7. Impact F1 direct flooding (fluvial or surface) of water resource assets leading to water resource asset loss



The major sources of water for the company are located on the Hampshire Avon and the Dorset Stour. All rivers are prone to flooding at some times just as extreme rainfall events could lead to possible surface flooding of assets. The need for water companies to review the risk posed to critical assets has been highlight on a number of occasions in the past. Although flooding is just one possible cause of failure for critical assets the company has been working for some years to increase the resilience of our network of sources, treatment works and distribution infrastructure. This has been done by ensuring the robustness of power supplies, providing inter-zonal links and ensuring that we have adequate storage.

To deal with the risk posed by flooding at key assets we have undertaken a review of the likelihood of this occurring and the consequences to service if such an event were to occur. This review identified individual parts of three water treatment works where there is a risk of flooding following an extreme rainfall event. Two of these are part of major treatment works and therefore their failure would have serious consequences.

From the principles set out in Ofwat's PR09/12 and consultation with the Environment Agency (EA) regarding predicted flood levels for certain return periods, we have put measures in place to mitigate these risks in the current 5 year asset management (AMP) period. As the interventions are small and only cover small parts of the cost of carrying out this work is relatively low.

As climate change scenarios change over time and the uncertainty around these scenarios is reduced we will review our exposure to flood risk and make any new investment we deem necessary.

Table 3.3.7 A. Relevant risk assessments from BWH Water Safety Plan (WSP)

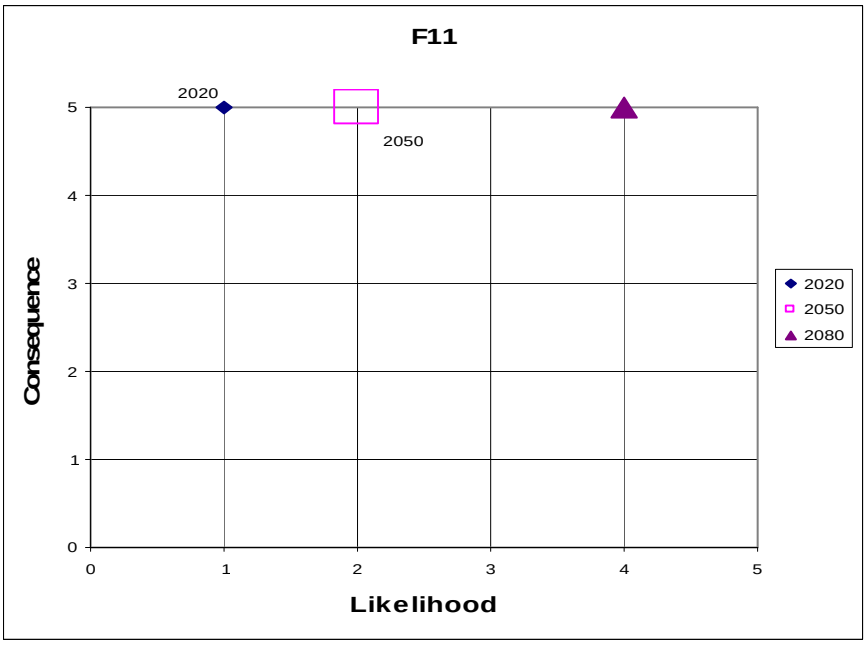
WSP ID	Hazardous event	Hazard
RA-WIM-32	Loss of power	Plant failure
RA-WIM-33	Catastrophic plant failure	Plant failure
RA-WIM-42	Site flooding	Flooding of critical plant rendering it inoperable
RA-WOOD-33	Catastrophic plant failure	Plant failure
RA-STAN-32	Loss of power	Plant failure
RA-STAN-33	Catastrophic plant failure	Plant failure
RA-KMA-47	Site flooding	Flooding of critical plant rendering it inoperable
RA-AMP-42	Site flooding	Flooding of critical plant rendering it inoperable

Table 3.3.7 B. Relevant risk assessments from BWH risk register

Risk register ID	Hazard
7	Major water supply failure (quality) resulting in compensation
91	Natural flooding of a site (Knapp Mill, Longham, Stanbridge)

Level of confidence in assessment	Comments
Medium	More data and further analysis of flooding impacts is needed

3.3.8. Impact F11 direct flooding (fluvial or surface) of treatment assets leading to water treatment asset loss



Water resource and water treatment assets are integrally linked; you cannot supply water if it cannot be treated. The likelihood of the loss of a treatment works through flooding is low however the consequence of such an event would be extremely high. We will continue to monitor and reassess the impact of flooding on these assets. See section 3.3.7 above for details regarding flood protection measures that are being undertaken at present We will continue to review our exposure to this risk in future business planning and make any new investment we deem necessary.

Table 3.3.8 A. Relevant risk assessments from BWH Water Safety Plan (WSP)

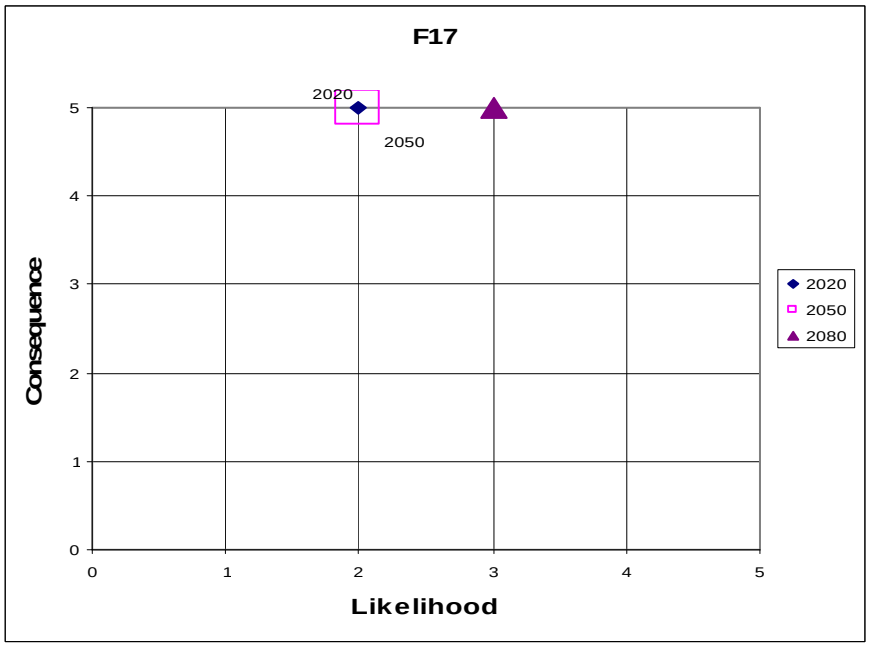
WSP ID	Hazardous event	Hazard
RA-AMP-36	Plant flow	Too high flow stressing treatment capability
RA-AMP-42	Site flooding	Flooding of critical plant rendering it inoperable
RA-KMA-4	Storm events causing agricultural run off	Stress treatment capability
RA-KMA-47	Site flooding	Flooding of critical plant rendering it inoperable
RA-STAN-32	Loss of power	Plant failure
RA-STAN-33	Catastrophic plant failure	Plant failure
RA-STAN-36	Plant flow	Too high flow stressing treatment capability
RA-WOOD-33	Catastrophic plant failure	Plant failure
RA-WOOD-36	Plant flow	Too high flow stressing treatment capability
RA-WOOD-42	Site flooding	Flooding of critical plant rendering it inoperable
RA-ALD-36	Catastrophic plant failure	Plant failure
RA-ALD-39	Plant flow	Too high flow stressing treatment capability
RA-WIM-36	Plant flow	Too high flow stressing treatment capability

Table 3.3.8 B. Relevant risk assessments from BWH risk register

Risk register ID	Hazard
7	Major water supply failure (quality) resulting in compensation
91	Natural flooding of a site (Knapp Mill, Longham, Stanbridge)
99	Water quality failure including contamination

Level of confidence in assessment	Comments
Medium	More data and further analysis of flooding impacts is needed

3.3.9. A. Impact F17 direct flooding (fluvial or surface) of network assets leading to water supply network asset loss



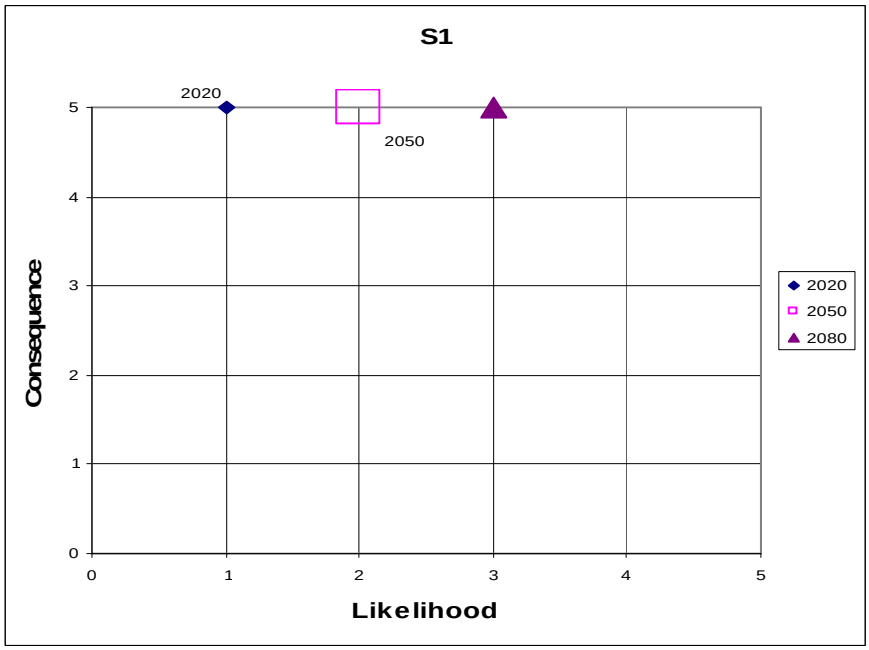
Our network is not particularly vulnerable to flooding however the consequence of the loss of network assets through flooding is high with many of our customers being affected. We will review our exposure to this risk in future business planning and make any new investment we deem necessary.

Table 3.3.9 A. Relevant risk assessments from BWH risk register

Risk register ID	Hazard
193	Loss of distribution network, supply zone
194	Loss of distribution network, water management zone
205	Missing of leakage targets
206	Long run loss of a trunk main
212	DG2 failure (poor pressure)
213	DG3 failure (interruption to supply)
215	Flooding properties
770	Contamination of water supply (underground)
754	Water flooding the road
490	Trunk or other main failure taking a long time to repair resulting in a loss of supply to a significant number of properties
92	Trunk main failure (Matchams/Longham, 3 x Longham/Alderney
93	Loss of Fawley main

Level of confidence in assessment	Comments
Medium	More data and further analysis of flooding impacts is needed

3.3.10. Impact S1 Direct flooding, storm damage, coastal erosion or planned retreat of water resources assets resulting form sea level rise



Rising sea levels pose a significant threat to all communities living near the sea. The probability of sea level rise affecting the company assets is low however the consequence of such an occurrence is high. The probability of occurrence increases with time from a very low probability in the next 25 years to it becoming a possibility by 2080.

One of our large treatment works is situated 1 km from the tidal limit on the river Avon and therefore there is a very slight possibility that in the distant future there could be some effect on the works as a result of the effects of sea level rise increasing the flooding potential of the river when high flows and high tides coincide.

Sea level rise ranges [27]

Administrative or Devolved Region	*Assumed Vertical Land Movement (mm/yr)*	*Net sea level rise (mm/yr) 1990-2025*	*Net sea level rise (mm/yr) 2025-2055*	*Net sea level rise (mm/yr) 2055-2085*	*Net sea level rise (mm/yr) 2085-2115*
South West and Wales	- 0.5	3.5	8.0	11.5	14.5
Rise		122.5mm	240mm	345mm	
Total predicted sea level rise		122.5mm	362.5mm	707.5mm	

The predicted sea level rise values in the table above give an indication as to the extent of sea level rise in our region. The actual impacts are unknown and

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http://www.defra.gov.uk/environment/flooding/documents/policy/guidance/fcdpag/fcd3climate.pdf

detailed modelling still has a great decree of uncertainty around the possible outcomes. The effects of sea level rise on the tidal limits on rivers is extremely variable as there are a huge number of parameters that need to be taken into account when trying to determine the extent of the upstream movement. Sea level rise will be occurring gradually over time and we will continue to monitor the extent of these effects. This will allow us to act with certainty once the impacts of sea level rise on our water resources assets are fully known.

Table 3.3.10 A. Relevant risk assessments from BWH Water Safety Plan (WSP)

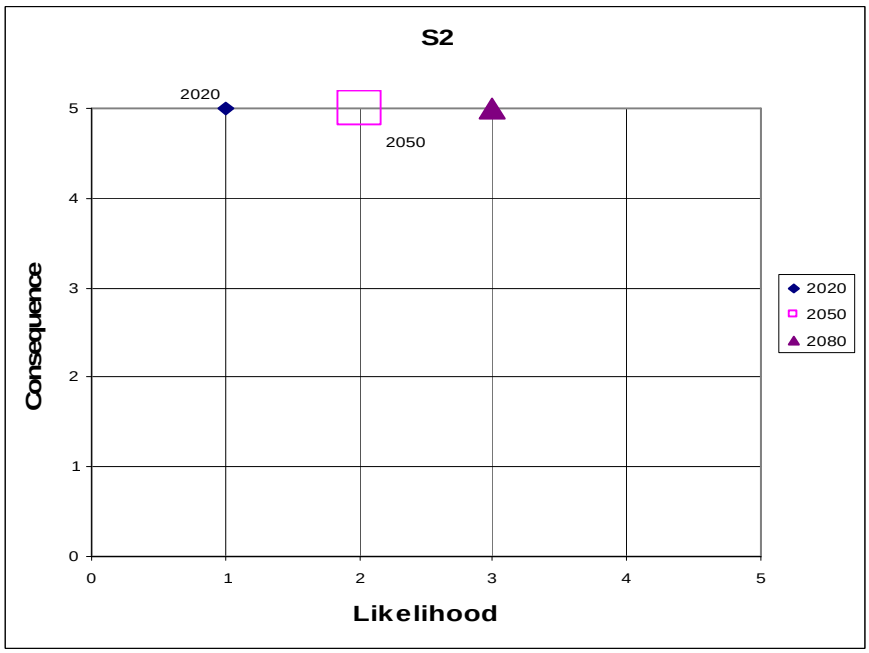
WSP ID	Hazardous event	Hazard
RA-KMA-47	Site flooding	Flooding of critical plant rendering it inoperable

Table 3.3.10 B. Relevant risk assessments from BWH risk register

Risk register ID	Hazard
91	Natural flooding of a site (Knapp Mill, Longham, Stanbridge)
94	Loss of primary filtration
74	Loss of Knapp Mill high lift

Level of confidence in assessment	Comments
Medium	This is an extremely unlikely impact

3.3.11. Impact S2 Saline intrusion into water resource assets resulting from a rise in sea levels



Saline intrusion is a high consequence very low probability risk. It is highly unlikely that company assets will be affected by saline intrusion. One of the largest company works is situated 1km from the tidal limit but due having a weir on the downstream side of the intake, sea level rise will have to be significantly higher than the estimated maximum predicted (see c.10). All other water resources assets are situated high enough above mean sea level not to be affected by this impact.

We will continue to monitor the impacts of sea level rise on our essential infrastructure and will act to mitigate any risks identified during future AMP periods.

Table 3.3.11 A. Relevant risk assessments from BWH risk register

Risk register ID	Hazard
91	Natural flooding of a site (Knapp Mill, Longham, Stanbridge)
193	Loss of distribution network, supply zone
194	Loss of distribution network, water management zone
205	Missing of leakage targets
206	Long run loss of a trunk main
212	DG2 failure (poor pressure)
213	DG3 failure (interruption to supply)
770	Contamination of water supply (underground)
490	Trunk or other main failure taking a long time to repair resulting in a loss of supply to a significant number of properties

Level of confidence in assessment	Comments
Medium	It is extremely unlikely that saline intrusion will affect service/assets

3.4. Opportunities as a result of climate change

3.4.1. Higher winter rainfall

All of our sources are reliant on winter recharge; the increase in winter rainfall will increase the water available in the summer.

3.4.2. More resilient infrastructure

In future we will design our infrastructure to cope with a greater range of impacts. This will serve to increase the resilience of our infrastructure and ensure that we maintain good levels of service.

Climate Change Adaptation Plan
Part 4
Actions proposed to address risks

Part 4 Index

4. Actions proposed to address risks

4.1. Adaptation actions for the top priority climate change risks

In order to ensure the company is able to adapt to the changing climate, we need to ensure that climate change risk assessment is clearly embedded in all corporate risk appraisal, business planning and decision making.

4.1.1. Risk Assessment

The qualitative risk assessment that was completed as part of this report was the beginning of this process. Now that we have an understanding of the possible future climate impacts, we need to ensure that the business has the capacity to adapt to the increased exposure to these risks that we expect in the future. For a water company the loss of the ability to supply water is our top priority risk, climate change will have a significant impact on water resources. One of the major strategic themes of our business plans is the use of demand management to maintain our healthy supply demand balance. We have a focus on metering, leakage reduction and water efficiency work to achieve this end. We will continue to monitor the effects of climate change on our supply demand balance and plan accordingly.

Although our qualitative risk assessment has not identified any climate change risks that fall outside of those already considered and evaluated in our corporate risk assessment documents and regulatory planning, it does not mean that this will always be the case. We need to ensure that all areas of our business take the future climate into account in all aspects of decision making, planning and day to day operations. This section sets out the framework for our climate change strategy. During our next asset planning (AMP) period we need to determine where our adaptive capacity is weakest and ensure that we address these weaknesses if they are found to reduce our resilience to risk.

4.2. Implementing adaptation into business practice

Building principles of sustainability and adaptability into the operation of our business ensures that we can achieve our goals of maintaining and improving service levels. As we have a corporate approach to risk identification and monitoring, the review of the climate change related risks must become a part of the process.

Table 4.2 below gives an outline of the mechanisms and processes we have in place to review risks in the corporate structure. We will now include climate change risks in all these assessments.

Table 4.2

Level	Process	Frequency	Comments
Strategic	Formal review of risk register and actions	2 per year	Formal process of review
Strategic	Review of key standards and policy objectives	As necessary	Based on political, regulatory and customer views
Company	Business plan	Every 5 years	Climate impacts to be taken into account for all business activities
Company	Water Resource Plan	Annual	Already takes climate change into account
Company	Review of Water Safety Plan	Annual	Climate change impacts to be included

Water services management teams meet monthly for an informal review of Water Safety Plans, Distribution operation and management strategy (DOMS) and the Capital Maintenance programme. Climate change risks will henceforth also be reviewed during these meetings.

4.3. Costs of adaptation measures

During our next Asset Management Plan (AMP) period we will completely review the risk assessment of climate change impacts. If we identify areas where work is needed these will be costed as part of our usual business planning. We do not have any capital schemes dealing specifically with climate change risks in this AMP period.

4.4. Reduction of risk as a result of adaptation

This is one of the most important strategic goals of the company; all the regulatory mechanisms that control the operation of a water company encourage the building of resilience into operations and assets. We are continually evaluating risks and investigating ways to ensure we can operate to the standards of service expected by our customers in all situations.

4.5. Embedding climate change risk management into the organisation

In order to embed climate change risk management across our organisation we intend to follow the steps listed below. [28]

4.5.1. Initiate change before the threat becomes severe

Through the process of completing the climate change adaptation plan we have identified the main climatic impacts that are expected to affect our business operations. Through the implementation of climate change adaptation into the everyday running of the business we will have the capacity to identify future risks and act to implement an adaptation action.

[28] Business for social responsibility: A Three-Pronged Approach to Corporate Climate Strategy

4.5.2. Allow sufficient time and resources for implementation, particularly in relation to core changes

Climate change affects all aspects of our organisation and therefore we can deal with any risk identified in our various reviews that is not acceptable to the business. These risks can then be addressed in our Periodic Reviews and Water Resource Plans

4.5.3. Build a broad base of change agents within the company

We need to build capacity across the entire business to deal with climate related risks. We will initiate a yearly report to educate and update all relevant parties across the business as to the latest climate change assumptions. We will also investigate educational opportunities for staff in order for them to be able to identify risks in their area of operation and collect good data for future quantitative analysis.

4.5.4. Alter work processes to establish changes

We need to initiate more comprehensive data management with regards the effects of extreme weather on our assets and work practices.

4.5.5. Build internal capacity, and avoid long-term dependence on external entities

This is an important part of our strategy to ensure that our company is flexible to risk. In our PR09 business plan we point out the benefits of producing our own energy and continue to investigate our options in this regard. We also identify our essential suppliers and the impacts of a loss of one of these and controls in place to deal with such an occurrence in our corporate risk management strategy.

4.5.6. Seek to support and inform change initiatives through existing professional networks

We are active members of industry wide networks that deal with climate change and its impacts.

4.5.7. Expand on established routines and competencies

Change is most effective when disruption to other business processes is minimal. We seek to enhance current processes such as Periodic Reviews, Water Resources Management Plans, Drought Plans, June Returns, reviews of corporate risk assessment and Water Safety Plans to ensure that climate change impacts are always taken into account.

4.5.8. Communicate early, fully and often

By embedding climate change goals and targets into regular communications with both staff and customers we hope to communicate our commitment to increasing our resilience to future climate impacts. We hope that this will enable them to make informed decisions regarding adaptation to climate change in their personal capacity.

4.5.9. Framework for implementing climate change adaptation into the everyday running of the business

In order to ensure the resilience of the organisation the adoption of climate change adaptation needs to be throughout the entire organisation. We will begin to implement this through a number of steps.

Step 1 Raise awareness
We will produce a summary of the climate change adaptation plan to be distributed to all members of staff. Further information and yearly updates will be provided in company publications. A briefing on climate change adaptation actions and progress will be reported in the annual staff briefing.

Step 2 Initiate organisational learning
Ensuring our members of staff are educated about the effects that future climate change will have on the business will ensure that climatic change becomes embedded in the culture of the organisation. By educating key staff members will also lead to better data collection and allow for better analysis of risks in the future.

Step 3 Changing standards and developing company policy
Climate change adaptation needs to be included in our current corporate risk appraisal process. We need to ensure that the executive monitor the outputs of the Climate Change Adaptation Plan

Step 4 Improve data collection and monitoring
We need to ensure that climate data is collected and the effects of climatic conditions on operations are monitored by all areas across the company. This will create an evidence base to help with future decision making.

Step 5 Create working partnerships
We need to inform all our stakeholders of our climate change adaptation measures that we have in place. Further to this engaging with suppliers and customers to ensure that they are taking climate change impacts into account will improve resilience of all parties. Linking with other reporting authorities in our area through initiatives such as the South West Climate Change Adaptation Mapping Resource website will allow for the sharing of information across various sectors.

Table 4.5.9 Implementation matrix

Step	Activity	Responsible department/person	Action	Due by
1 Raising awareness	Ensure all staff are aware of the climate change impacts on the business and what is being done	Regulation	Produce a notice for all staff outlining our climate change adaptation plan. Ensure that staff are kept up to date of yearly reviews of the plan in company publications	March 2011
1 Raising awareness	Ensure all customers are aware of the companies CCA strategy	Regulation	Provide an summary of the climate change adaptation strategy in customer publications	March 2012
2.Organisational learning	Ensure all key staff members are educated about the impacts of climate change and how it affects their area of operation	Regulation	Initiate and annual review meeting with heads of departments to review climate change adaptation report	Jan 2012
3 Changing standards and developing company policy	Ensure climate change adaptation is implemented into all risk, standards and key policy reviews	Executive	Change these processes and procedures to ensure CCA is taken into account	July 2011
4. Data collection and monitoring	Formal yearly review of CCA plan	Regulation	Review CCA plan to ensure that all assumptions and actions are up-to-date.	Jan 2012
4. Data collection and monitoring	Ensure climatic data is recorded and effects of conditions on areas of operation are noted	Heads of departments/Regulation	Initiate yearly departmental climate reports to go into a company climate change evidence base	March 2012
5 Creating working partnerships	Ensure key suppliers and customers are informed about our CCA strategy.	Corporate services	Provide access to CCA report and yearly updates	March 2011
5 Creating working partnerships	Ensure that other reporting authorities are aware of our CCA plan	Regulation	Publish CCA report on the South West Climate Change Adaptation mapping resource website	Jan 2011

Climate Change Adaptation Plan
Part 5
Uncertainties and assumptions

Part 5 Index

5. Uncertainties and assumptions

We have a general idea of what conditions to expect however, projecting 50 plus years into the future presents us with a large degree of uncertainty. In order to get an idea of future conditions we have made a number of assumptions about future impacts facing the company. We acknowledge that these assumptions could change in light of new information and therefore we have mechanisms in place to allow for the assumptions used in this report to be reviewed and updated. This will ensure that we remain flexible and resilient to potential future hazards facing the organisation.

5.1. Main uncertainties in the evidence, approach and method used in the adaptation programme and the operation of the organisation

The main uncertainties faced by the company are linked to the large variations in future climate scenarios and the robustness of data used to analyse the effects of climate on operations.

5.1.1. Evidence

The impacts of climate change on the company have been taken from the MWH-Water UK study[29] . This provides general impacts for all water companies and therefore gives a broad range of possible impacts that could be experienced by a water company. Due to these impacts not being company specific there is a possibility that localised impacts could arise that have not been covered in the study.

Data relating to the effects of climatic conditions on operations is not robust across all areas of the business. In future we need ensure that relevant data is collected in order to allow for more quantitative analysis.

5.1.2. Approach

Our approach to climate change adaptation allows climate change risk to be managed through multiple interventions over time. Large capital schemes require good data and need a high level of confidence that the solution will be successful and an efficient use of money. In certain cases, such as for very long life assets a more favourable solution sometimes requires a single intervention. However the uncertainty around the future conditions and current level of data quality constrains us to following a step by step approach to manage climate change risks.

[29] Water UK A Climate Change Adaptation Approach for Asset Management Planning 41414874 V1.0

5.1.3. Method

Where possible we have followed the UKCIP decision making framework when evaluating the impacts of climate change on our business. Our qualitative risk assessment has been carried out by relevant experts across the company. This was done by evaluating the impacts identified in the Water UK study in terms of the UKCIP 09 climate projections. In future iterations of the CCA plan we need to ensure more quantitative analysis is undertaken of both the predicted climatic conditions and the impact that these will have on the operation of the business.

5.1.4. Operation of the organisation

We are a small and local company compared to most other water which does increase operational risk slightly. Due to the small size of the company there are key staff members across the organisation that hold valuable information and expertise that is vital to the carrying out of our functions. This is especially the case when determining the effects of extreme weather on various areas of the business.

This information needs to be recorded and stored in order that the organisation is less reliant on these members of staff. This plan will serve as a catalyst to improve the way operational data is stored and managed with regards to the effects of extreme weather.

5.2. Assumptions that have been made when devising the programme for adaptation

5.2.1. The water industry

We assume that the water industry will exist in future in its current form with the same regulators and regulatory regime that we currently experience.

5.2.2. Emissions scenarios

Future climatic conditions will result from an atmospheric carbon content equal or less than the medium emissions scenarios provided by UKCIP. We assume that the government will achieve the targets set in the Climate Change Act 2008 to reduce emissions by 80% by 2050.

5.2.3. Levels of service

We will continue to maintain or improve our levels of service based on the wishes of our customers and key stakeholders.

5.2.4. Assessment of impacts

Assessments of impacts on areas of operation have been carried out by experts in those fields and their judgement of the impacts and effects constitutes the best possible information available at present.

5.2.5. Implementation of policies and procedures

We assume that the procedures we are putting in place to mainstream climate change adaptation into the everyday decisions and planning will be effective in achieving this end. We will review these procedures on a regular basis to ensure that climate change adaptation becomes integral to the operation of the business.

Climate Change Adaptation Plan
Part 6
Barriers to adaptation and interdependencies

Part 6 Index

6. Barriers to adaptation and interdependencies

6.1. Barriers to implementing our adaptation programme

Implementation of the climate change adaptation plan is essential if we are to ensure the resilience of our business. We have not at present identified any immediate actions that need to be carried out to deal with a risk to the business arising from climate change. Implementing the programme is a process of setting up mechanisms within the organisation that will allow for accurate monitoring and evaluation of the impacts of climate on the business and for this to be successful the following barriers will need to be overcome.

6.1.1. Behaviour change

This report serves to highlight the areas where we could expect an impact in future. The significance of this is that we need to put in place measures to ensure that we are constantly monitoring and evaluating the effects of climate on our everyday operations. An important aspect of getting these measures in place across the business is the behavioural change needed in staff. The entire organisation needs to buy in to the concept of climate change adaptation in order to ensure resilience to the impacts.

According to the Defra report “Mobilising individual behavioural change through community initiatives: Lessons for Climate Change”.[30] Mobilising support for changing behaviour presents difficulties because; to get communities to take these behaviours on board the issue needs to be, locally relevant, have known beneficiaries and benefits from the action. When we contrast these with climate change issues, these impacts are long term, the benefits accrued are unknown and the actions undertaken by the individual make little difference when compared to the scale of the threat.

6.1.2. Reliability of data

Sound data is needed to ensure that we are following the correct programme of measures in our climate change adaptation strategy. If the data used to determine our strategy is unreliable we will not be able to make informed decisions. This will lead to incorrect and unsuitable actions being taken or no action being taken when action is needed.

[30] Mobilising individual behavioural change through community initiatives. Lessons for Climate Change Report by the Centre for Sustainable Energy (CSE) and Community Development Xchange (CDX) for; Department for Environment, Food and Rural Affairs, Communities and Local Government, Department of Trade and Industry, Department for Transport and, Her Majesty’s Treasury**.** February 2007

6.1.3. Regulatory constraints

All water companies are subject to a high degree of regulatory scrutiny. When making any investment decisions, we have to prove that our actions are justified and cost beneficial. We also need to use our resources in the most efficient manner. Therefore we need to be certain that when an investment decision is made it is based on the best evidence possible. Due to the uncertainty around the predicted future conditions and lack of data in certain areas, it becomes difficult in certain cases to justify actions that may be needed to address future climate change.

We need to maintain good communications with our various regulators and ensure that they are communicating with one another. As a result of our various regulators having their own specific areas of interest there is a possibility that in future an output from one regulator may contradict that required by another.

6.1.4. Carbon Impact

Many adaptation measures that will be required in future may be hard engineering solutions. These may have a significant carbon footprint and thereby accelerate climate change

6.2. How these barriers are being addressed

6.2.1. Addressing behaviour change

To overcome the issue of staff stakeholder buy in we are putting in place measures to educate staff this will be done through awareness raising and organisational education initiatives.

6.2.2. Addressing the reliability of data

We are introducing new procedures for the collection of climatic data; part of improving our data collection is linked to educating the staff to highlight the importance of the data that they are collecting. In future iterations of the climate change adaptation plan we will then be able to do more quantitative analysis, which will enable us to highlight impacts that need to be addressed in future regulatory planning processes.

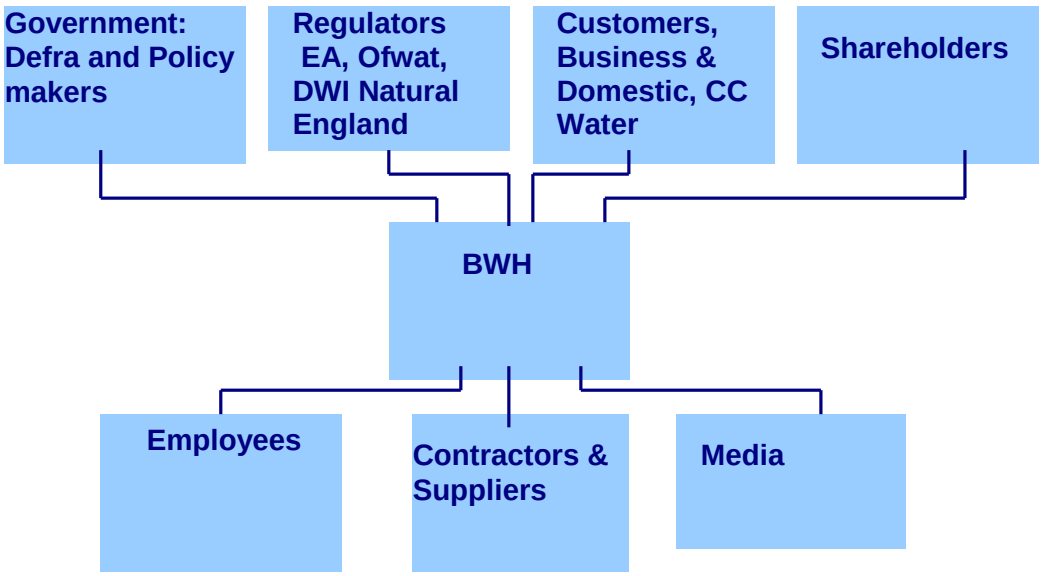
6.2.3. Addressing regulatory constraints

By improving the collection of climate data across the organisation we will be able to provide better quantitative analysis for future regulatory price reviews. By communicating in an open manner with our regulators we hope to avoid situations where outputs required by different regulators are at odds.

6.3. Interdependencies

Climate change has wide ranging effects on our society. As our customers, suppliers and other stakeholders depend on us, as we are in turn depend on them.

6.3 Key stakeholders



6.3.1. Customers

We provide an essential public service to our customers. The way that our customers use water directly affects our response to extreme weather conditions. Customer side interventions form an integral part of our demand management strategy, therefore we are reliant on customers reducing their water usage to manage peak summer demand.

6.3.2. Suppliers

We have risk management procedures in place for the loss of essential suppliers; these are detailed in the Water Safety Plan and Company Risk Register. However we need to ensure that our key suppliers are also resilient to the effects of climate change to ensure that we can maintain our levels of service under all conditions and only resort to our other contingencies in the most extreme circumstances.

6.3.3. Employees and shareholders

Our employees and shareholders depend on the functioning of the business for their livelihood. The business in turn needs finance and manpower to carry out its functions. Both staff and shareholders need to be aware of the issues faced by the company with regards to dealing with climate change. The first two steps of our climate change adaptation plan implementation strategy involve raising awareness and organisational learning, which will facilitate this. Having staff and shareholders support in delivering on climate change adaptation strategy will ensure its success and therefore the continued functioning of our business through all future uncertainties.

6.3.4. Government DEFRA and policy makers

We are an essential public service appointed by statute. It is therefore in the interest of both parties to ensure that we continue to provide our service as a failure to do so would reflect on the government and lead to widespread dissatisfaction among the electorate.

6.3.5. Regulators

The water industry is heavily regulated, with much of what we do coming under close scrutiny. We need to ensure that we continue to meet our regulatory obligations into the future.

As the effects of climate change become more widespread we predict that we will come under increasing pressure from our regulators to achieve the outputs that are set for us.

Our economic targets set by Ofwat will require sound evidence that we are performing in a sustainable efficient manner whilst the environmental regulators Natural England NE and the Environment Agency EA will expect us to operate in a manner that has the least negative impact on the environment.

Over and above these pressures we will also be required by the Drinking Water Inspectorate (DWI) to produce water to the highest possible standard. It is essential that we work together with the various regulators to achieve all the regulatory outputs required of us, by doing so we will ensure that we maintain our world class service long into the future.

We need to ensure that we maintain open communications with our regulators and encourage our regulators to communicate with one another to guarantee that we are all working together to achieve the same end.

Climate Change Adaptation Plan
Part 7
Monitoring and evaluation

Part 7 Index

7. Monitoring the outcome of the adaptation programme

7.1. Monitoring the outcomes of the adaptation programme

The Climate Change Adaptation Plan (CCA) is an iterative document. As has been pointed out in section 4 we have now incorporated climate change adaptation into our corporate reporting structures, this will ensure that any climate change related issues are identified and the subsequent adaptation actions are closely monitored.

7.1.1. Monitoring action plan

The following outcomes of this plan will need to be monitored in order to ensure that climate change adaptation becomes embedded in the organisation.

Table 7.1.1

Action	Responsibility	Mechanism	Frequency
Monitoring the outcomes of the adaptation programme	Executive	Climate change adaptation plan review	Yearly
Monitoring and incorporation of climate change threshold into future risk assessment	Regulation	5 year Regulatory Business Plan	Every 5 years
Monitoring the residual risks on stakeholders and the organisation	Regulation	5 year Regulatory Business Plan	Every 5 years

7.2. Monitoring and incorporation of climate change threshold into future risk assessment

In section 1 we identify approximate future conditions taking into account the impacts of climate change. We also make a comparison with the most extreme conditions we have experienced in the past. This serves to provide an estimation of the thresholds above which the company will encounter difficulty in carrying out its operations.

Future climate change scenarios will be updated when our understanding of these improves. We will continue to monitor these scenarios in our yearly updates of the Climate Change Adaptation Plan and update our estimations of thresholds where necessary.

7.3. Monitoring the residual risks on stakeholders and the organisation

The residual risks include those that remain after the known risks have been dealt with. With better monitoring and data we will be able to quantify risks in a more accurate way thereby reducing residual risks on both stakeholders and the organisation

7.4. Ensuring the management of climate change risk is firmly embedded into the organisation

Embedding climate change risk management into the organisation is a strategic goal. In part 4 of this report we describe this in more detail. In particular part 4. describes how we intend to embed climate change risk into the organisation and table 4.2 gives a breakdown of the processes to which climate change adaptation has been included. Climate change adaptation will be embedded in the in the organisation through

- Raising awareness
- Developing organisational learning
- improving data collection and monitoring
- Changing standards and company policies
- Creating working partnerships with stakeholders

7.5. Ensuring climate change risk management is flexible

By continuously reviewing the risks and assumptions around climate change we intend to identify risks before they become a problem. We view climate change risks in the same light as all risks facing the company. As a result of all strategic risks having regular reviews we can determine if a risk will reach a level where it is unacceptable to the company.

7.6. Impacts of this report on climate change management

Due to the long term planning and resilient management required by our regulators climate change is already taken into account in many key areas of operation. This report serves as a means of ensuring that climate change adaptation is taken into account across all areas of operation, ensuring that we do not overlook any processes that at present are not affected by climatic conditions but could be affected in future.

Climate Change Adaptation Plan Appendices

Appendix 1

Future climate change predictions for South West England

In general terms the climate change predictions as set out in The UK Climate Projections[31] predict that:

- the UK will continue to get warmer
- summers will continue to get hotter and drier for much of the UK
- winters will continue to get milder and wetter
- some weather extremes will become more common, others less common
- sea level will continue to rise.

The following tables give an example of the extent of anticipated change in rainfall and temperature for the 2050's, sea level rise estimates and an estimate of the change in the frequency of extreme weather events for our region. We use these projections to aid our adaptation decision making and assessment of climate related risks.

[31] http://ukclimateprojections.defra.gov.uk/

Table 1: Key findings for South West England, 2050s [32]

Medium emissions 2050's	*Central estimate*	*Change*	*Most likely range*
Winter mean temperature	2.1ºC	Increase	1.1ºC to 3.2ºC
Summer mean temperature	2.7ºC	Increase	1.3ºC to 4.6ºC
Summer mean daily maximum temperature	3.8ºC	Increase	1.4ºC to 6.8ºC
Summer mean daily minimum temperature	2.9ºC	Increase	1.2ºC to 5ºC
Annual mean precipitation	0%	No Change	–5% to 6%
Winter mean precipitation	17%	Increase	4% to 38%
Summer mean precipitation	–20%	Decrease	–42% to 7%

Medium emissions 2080's	*Central estimate*	*Change*	*Most likely range*
Winter mean temperature	2.8ºC	Increase	1.6ºC to 4.3ºC
Summer mean temperature	3.9ºC	Increase	2.1ºC to 6.4ºC
Summer mean daily maximum temperature	5.4ºC	Increase	2.2ºC to 9.6ºC
Summer mean daily minimum temperature	4.1ºC	Increase	1.9ºC to 7.1ºC
Annual mean precipitation	1%	Increase	–5% to 7%
Winter mean precipitation	23%	Increase	6% to 54%
Summer mean precipitation	–24%	Decrease	–50% to 6%

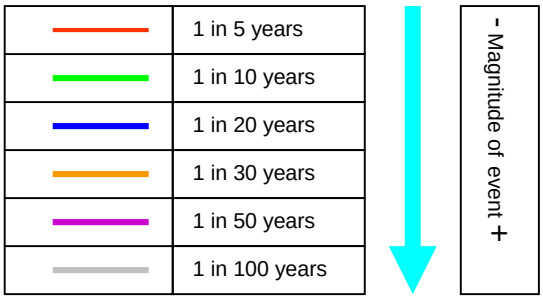
[32] http://ukclimateprojections.defra.gov.uk/content/view/2271/528

Table 2: Sea level rise and sensitivity ranges for climate change parameters [33]

Administrative or Devolved Region	*Assumed Vertical Land Movement (mm/yr)*	*Net sea level rise (mm/yr) 1990-2025*	*Net sea level rise (mm/yr) 2025-2055*	*Net sea level rise (mm/yr) 2055-2085*	*Net sea level rise (mm/yr) 2085-2115*
South West and Wales	- 0.5	3.5	8.0	11.5	14.5

Changes in the frequency of extreme rainfall events over time [34]

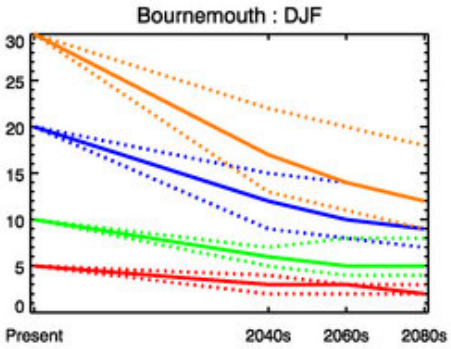
According to the Met Office analysis the uncertainty in the change in summer rainfall is generally larger than that for winter rainfall. The report shows that for most locations, there is no clear indication. Summer rainfall extremes could either increase in frequency or decrease. The greatest uncertainty in summer rainfall is found for locations in the South and South-East which includes the towns/cities Norwich, Cambridge, Ipswich, London, Canterbury, Brighton, Portsmouth, Bournemouth, Southend-on-Sea and Basingstoke.

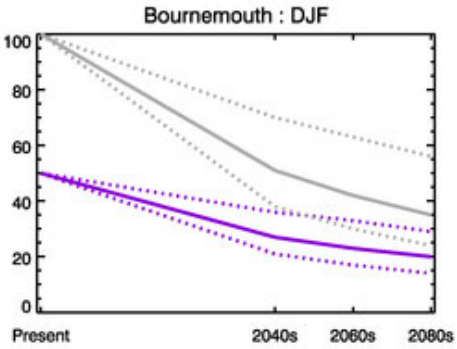


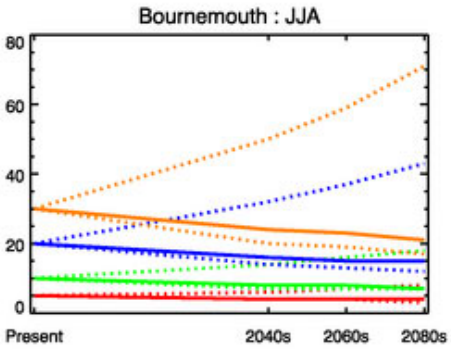
As is evident from the figures below, the frequency of winter rainfall events December, January, February (DJF) shows a trend of increasing at a greater rate than summer rainfall events June, July , August (JJA).

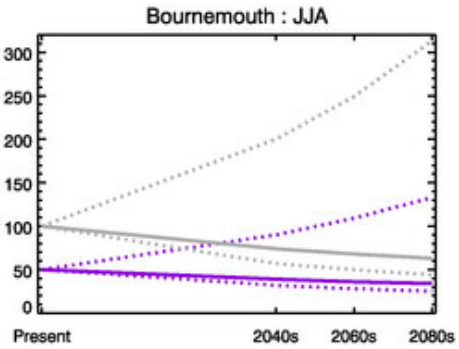
33 http://www.defra.gov.uk/environment/flooding/documents/policy/guidance/fcdpag/fcd3climate.pdf

34 Changes in extreme rainfall events for selected towns and cities, A Met Office report for OFWAT July 2010


Bournemouth : DJF
30
25
20
15
10
5
0
Present
2040s
2060s
2080s


Bournemouth : DJF
100
80
60
40
20
0
Present
2040s
2060s
2080s


Bournemouth : JJA
80
60
40
20
0
Present
2040s
2060s
2080s


Bournemouth : JJA
300
250
200
150
100
50
0
Present
2040s
2060s
2080s

Appendix 2

Summary of all impacts and consequences for a water only company[35]

ASSET LEVEL 3	REF	IMPACT TYPE	PRESSURE…	CONSEQUENCE FOR ASSETS & OPERATIONS	CONSEQUENCE FOR SERVICE
All Site wide Services	D41	DROUGHT	Exfoliation cracks in storage basin affecting coatings/seals, clay liner failure	accelerated asset deterioration	
All Site wide Services	D42	DROUGHT	Relocation of population from drought	affecting supply-demand balance and other aspects	
All Site wide Services	F48	FLOOD	Direct asset flooding	asset loss	service failure
All Site wide Services	F49	FLOOD	Direct asset flooding	reduced access to assets; H&S risk for site staff	
All Site wide Services	F50	FLOOD	More frequent storms and power supply flooding,	power outages	service failure
All Site wide Services	F51	FLOOD	Direct flooding of electrical assets,	risk to staff of electrocution	
SCADA & Telemetry	F52	FLOOD	Flooding	loss of SCADA / telemetry	service failure
All Site wide Services	S27	SEA LEVEL	Direct asset flooding	asset loss	service failure
All Site wide Services	S28	SEA LEVEL	Direct asset flooding	reduced access to assets, endangering H&S of site staff	
All Site wide Services	S29	SEA LEVEL	Direct asset flooding, storm damage, coastal erosion or planned retreat	asset loss	service failure
All Site wide Services	S30	SEA LEVEL	Saline intrusion	accelerated asset deterioration	
SCADA & Telemetry	S31	SEA LEVEL	Direct flooding of electrical assets	higher risk to staff of electrocution	
All Site wide Services	T55	TEMP. RISE	Higher levels of UV	higher risk of sun-related injury and illness	
All Site wide Services	T56	TEMP. RISE	Higher average and peak temperatures		greater incidence of water & wetland associated disease
All Site wide Services	T57	TEMP. RISE	Higher average and peak temperatures	accelerated deterioration of structures, buildings, machinery, equipment	
All Site wide Services	T58	TEMP. RISE	Higher temperatures	increasing vegetation growth at sites	
All Water Networks	D17	DROUGHT	Higher daily & peak demand for garden watering,		

[35] Water UK A Climate Change Adaptation Approach for Asset Management Planning 41414874 V1.0

Distribution networks incl. ancillaries	D18	DROUGHT	Loss of / intermittent supply	increased risk of external contaminants entering supply pipelines	contamination of drinking water
Distribution networks incl. ancillaries	D19	DROUGHT	Loss of supply and depressurisation of the supply network,	more frequent pipe failure	contamination of drinking water
Distribution networks incl.	D20	DROUGHT	Loss of / intermittent supply	increases risk of mechanical asset failure (eg in PRVs)	service failure
Distribution pumping stations	D21	DROUGHT	Loss of supply and depressurisation of the supply network,	more air blockages and service failure	service failure
Distribution storage	D22	DROUGHT	Lower flow rates	deposition, reducing raw water quality	
Distribution storage	D23	DROUGHT	Loss of supply or intermittent supplies	contamination from accumulated silt and debris being flushed out of service reservoirs and towers	higher drinking water quality risk
All Water Networks	F17	FLOOD	Direct asset flooding	asset loss	service failure
All Water Networks	F17 A	FLOOD	More frequent storms and power supply flooding,	power outages	service failure
Distribution networks incl. ancillaries	F18	FLOOD	Flooding	infiltration into pipelines	increasing drinking water quality risk
Distribution networks incl. ancillaries	F19	FLOOD	Direct flooding	contaminants enter pipelines	higher drinking water quality risk
Distribution storage	F20	FLOOD	Direct flooding	contaminants enter underground storage tanks	higher drinking water quality risk
All Water Networks	G2	GENERAL	Relocation of population from weather, flooding, sea level rise	affecting supply-demand balance, network capacity etc	
All Water Networks	S11	SEA LEVEL	Direct asset flooding, storm damage, coastal erosion or planned retreat	asset loss	service failure
All Water Networks	T19	TEMP. RISE	Higher average and peak temperatures	accelerated deterioration of structures, buildings, machinery, equipment	
Distribution networks incl. ancillaries	T20	TEMP. RISE	More extreme wetting and drying cycles	greater soil movement, more pipe movement and bursts	
Distribution networks incl. ancillaries	T21	TEMP. RISE	Increased micro-biological growth,	higher risk of residual chlorine depletion, contamination of supplies	higher drinking water quality risk
Distribution storage	T22	TEMP. RISE	Higher peak demand	leading to greater storage requirements reducing security of supply (??)	
Distribution storage	T23	TEMP. RISE	Increased micro-biological growth,	higher risk of residual chlorine depletion, contamination of supplies	higher drinking water quality risk
All Water Resources	D1	DROUGHT	Reduced available supply	reduced security of supply	pressure on water users
All Water Resources	D2	DROUGHT	Higher daily & peak demand for garden watering,	lower security of supply	[ ]
All Water Resources	D3	DROUGHT	Intake, borehole pump and reservoir draw-off levels do not match reduced levels		service failure
All Water Resources	D4	DROUGHT	Lower river & borehole yields or reduced water quality,	abstraction licences reduced or removed, reducing security of	

				supply	
All Water Resources	D5	DROUGHT	Drier conditions	security of supply	increasing customer sensitivity to possibility of service failure, affecting security of supply
Storage Reservoirs & Aqueducts	D6	DROUGHT	Lower river flows	lower yields, increasing demand on existing storage, reducing in security of supply	
Boreholes / source pumping stations	D7	DROUGHT	Lower groundwater levels	reducing borehole yields, reducing security of supply	
Raw water pipelines	D8	DROUGHT	Lower flow rates	deposition; reduced raw water quality	
Intake Pumping stations	D9	DROUGHT	River levels fall,	reduced reliability as water sources, reducing security of supply	
All Water Resources	F1	FLOOD	Direct asset flooding	asset loss	service failure
Intake Pumping stations	F10	FLOOD	More storm water,	increased pump usage & accelerated asset deterioration	
All Water Resources	F2	FLOOD	More frequent storms and power supply flooding,	power outages	service failure
All Water Resources	F3	FLOOD	Movement of permanent population (eg away from flood plains) and tourism due to flooding,		impacts on demand and security of supply
All Water Resources	F4	FLOOD	The threat of assets being flooded		higher customer expectations for visible hard engineering adaptation solutions
Storage Reservoirs & Aqueducts	F5	FLOOD	Increased soil erosion	siltation of dams, accelerating asset deterioration	
Storage Reservoirs & Aqueducts	F6	FLOOD	More intense rainfall events & changes to soil conditions	slippage of soil dams, asset loss	service failure, customer flooding
Storage Reservoirs & Aqueducts	F7	FLOOD	More intense rainfall events	overwhelming spillways, asset loss	service failure, customer flooding
Boreholes / source pumping stations	F8	FLOOD	More intense rainfall compacting upper soil layers,	more run-off, less recharge of aquifers, lower security of supply	
Raw water pipelines	F9	FLOOD	Flooding	infiltration into pipelines	increasing drinking water quality risk
All Water Resources	S1	SEA LEVEL	Direct asset flooding, storm damage, coastal erosion or planned retreat	asset loss	service failure
All Water Resources	S2	SEA LEVEL	Saline intrusion	accelerated asset deterioration	[ ]
All Water Resources	S3	SEA LEVEL	Movement of permanent population (e.g. away from flood plains) and tourism due to flooding,		impacts on demand and security of supply
Boreholes / source pumping stations	S4	SEA LEVEL	Saline intrusion	decreasing yields, causing reduction in security of supply	service failure

Intake Pumping stations	S5	SEA LEVEL	Tidal limits moving upstream and increasing salinity at intakes,	raw water resource loss and reduced security of supply	
All Water Resources	T1	TEMP. RISE	Higher average and peak temperatures	accelerated deterioration of structures, buildings, machinery, equipment	
All Water Resources	T2	TEMP. RISE	Redistribution of / increase in tourism	reduced security of supply	increased seasonal demand,
All Water Resources	T3	TEMP. RISE	Higher daily and peak domestic and commercial demand,	reduced security of supply	
All Water Resources	T4	TEMP. RISE	Higher temperatures and longer growing season	redistribution of / increase in agricultural demand and impacts on security of supply	
All Water Resources	T5	TEMP. RISE	Redistribution of permanent population with warmer conditions,		impacts on demand and security of supply
All Water Resources	T6	TEMP. RISE	Higher temperatures	security of supply	increasing customer sensitivity affecting security of supply
Storage Reservoirs & Aqueducts	T7	TEMP. RISE	Increased evapotranspiration,	lower infiltration and borehole yields, reducing security of supply	
Storage Reservoirs & Aqueducts	T8	TEMP. RISE	Increased evapotranspiration	lower surface reservoirs yields; greater reliance on groundwater recharge, reducing security of supply	
Boreholes / source pumping stations	T9	TEMP. RISE	Increased evapotranspiration,	lower infiltration and borehole yields, reducing security of supply	
All Water Treatment	D10	DROUGHT	Low flows	lead to greater sedimentation & blockages	service failure
Treatment works	D11	DROUGHT	Reduced raw water volumes reducing dilution		increase drinking water quality risk
Service Reservoirs & Water Towers	D12	DROUGHT	Intermittency in supply	silt and debris accumulating in service reservoirs and towers	higher drinking water quality risk
Service Reservoirs & Water Towers	D13	DROUGHT	Loss of / intermittent supply	increases risk of external contaminants entering supply pipelines	
Service Reservoirs & Water Towers	D14	DROUGHT	Loss of supply and de-pressurisation	more frequent pipe failure	contamination of drinking water
Service Reservoirs & Water Towers	D15	DROUGHT	Inversions occur more frequently with low water levels;	Cryptosporidium accumulation	higher drinking water quality risk
Treated water pumping stations	D16	DROUGHT	Loss of supply and depressurisation of the supply network,	more air blockages	service failure
All Water Treatment	F11	FLOOD	Direct asset flooding	asset loss	service failure
All Water Treatment	F12	FLOOD	More frequent storms and power supply flooding,	power outages	service failure
Treatment works	F13	FLOOD	More intense rainfall events		discolouration and odour problems for drinking water

					(through biological consequences)
Treatment works	F14	FLOOD	Increased runoff	higher sediment levels	higher drinking water quality risk
Service Reservoirs & Water Towers	F15	FLOOD	Direct flooding	contaminants enter underground storage tanks	higher drinking water quality risk
Service Reservoirs & Water Towers	F16	FLOOD	Direct flooding	contaminants enter pipelines	higher drinking water quality risk
All Water Treatment	G1	GENERAL	Relocation of population from weather, flooding, sea level rise	affecting supply-demand balance, treatment works, asset capacity etc	
Treatment works	S10	SEA LEVEL	Tidal limits moving upstream and increasing salinity at intakes,	raw water resource loss and reduced security of supply	
All Water Treatment	S6	SEA LEVEL	Direct asset flooding, storm damage, coastal erosion or planned retreat	asset loss	service failure
All Water Treatment	S7	SEA LEVEL	Saline intrusion in groundwater	accelerated asset deterioration	[ ]
All Water Treatment	S8	SEA LEVEL	Sea level rise	increases frequency of power loss	service failure
Treatment works	S9	SEA LEVEL	Saline intrusion	decreasing yields, causing reduction in security of supply	service failure
All Water Treatment	T10	TEMP. RISE	Higher temperatures	more algal growth and micro-organisms in the water supply system	higher drinking water quality risk
All Water Treatment	T11	TEMP. RISE	Higher average and peak temperatures	accelerated deterioration of structures, buildings, machinery, equipment	
Treatment works	T12	TEMP. RISE	Higher temperatures	lower raw water quality	greater risk to drinking water quality
Treatment works	T13	TEMP. RISE	Higher temperatures	impacts on treatment process	improving treated water quality
Treatment works	T14	TEMP. RISE	More frequent disease increasing drinking water quality risk	additional potable water standards	
Treatment works	T15	TEMP. RISE	Higher temperatures		discolouration and odour problems for drinking water (through biological consequences)
Service Reservoirs & Water Towers	T16	TEMP. RISE	Increased micro-biological growth,	higher risk of residual chlorine depletion, contamination of supplies	higher drinking water quality risk
Service Reservoirs & Water Towers	T17	TEMP. RISE	Increased micro-biological growth,	higher risk of residual chlorine depletion, contamination of supplies	higher drinking water quality risk
Service Reservoirs & Water Towers	T18	TEMP. RISE	More extreme wetting and drying cycles	greater soil movement, more pipe movement and bursts	

Appendix 3

Summary of the highest scoring strategic climate change impacts faced by the company and associated risks for UKCIP planning horizons 2020's, 2050's and 2080's

Table 3.1 2020's Short term risk

ASSET AFFECTED		Droughts (lower rainfall)	Info Source Ref			
	Impact	All Drought Impacts				
		105, 106, 108, 209, 213, 223, 303, 314, 404, 410, 412, 414		**Likelihood**	**Level of consequence**	**Score**
All Water Resources	D2	Daily & peak demand for 'garden' watering increases, causing **a reduction in security of supply**	**117, 401**	2	5	**10**
	D4	Lower river yields, borehole yields or reduced water quality lead to abstraction licences being reduced or removed, causing a **reduction in security of supply**	**224, 405, 416, 417**	2	5	**10**
ASSET AFFECTED		**Temperature rise**	**Info Source Ref**			
	Impact	All Temperature Rise Impacts				
		303, 314, 404, 410, 412, 414		**Likelihood**	**Level of consequence**	**Score**
All Water Treatment	T10	Increased algal growth and risk of microscopic organisms within the water supply system **increases drinking water quality risk**	**318**	3	3	**9**
	T11	Higher average and peak temperatures affect structures, buildings, H & V, MEICA plant working life, causing **accelerated asset deterioration**		2	4	**8**
All Water Networks	T19	Higher average and peak temperatures affect structures, buildings, H & V, MEICA plant working life, **causing accelerated asset deterioration**	**318**	2	4	**8**
ASSET AFFECTED		**Flooding**	**Info Source Ref**			
		104, 205, 206, 207, 303,314, 402, 404, 410, 412, 414		**Likelihood**	**Level of consequence**	
All Water Networks	F17	Direct asset flooding causes **service failure and asset loss**	**201, 215, 304, 406**	2	5	**10**
All Site wide Services	F51	Direct flooding leads to submersion of electrical assets, increasing risk to operatives of electrocution **endangering H&S of site staff**		2	5	**10**

Table 3.2 2050's Medium term risk

ASSET AFFECTED		Droughts (lower rainfall)	Info Source Ref			
	Impact	**105, 106, 108, 209, 213, 223, 303, 314, 404, 410, 412, 414**		**Likelihood**	**Level of consequence**	**Score**
All Water Resources	D2	Daily & peak demand for 'garden' watering increases, causing **a reduction in security of supply**	**117, 401**	2	5	**10**
	D4	Lower river yields, borehole yields or reduced water quality lead to abstraction licences being reduced or removed, causing a **reduction in security of supply**	**224, 405, 416, 417**	2	5	**10**
Storage Reservoirs and Aqueducts	D6	Lower river flows reduce yields and hence increased demand on existing storage, and causes a **reduction in security of supply**	**224, 405, 416, 417**	3	3	**9**
Intake Pumping stations	D9	River levels fall and they become less reliable sources, **reducing security of supply**	**224, 405, 416, 417**	3	3	**9**
ASSET AFFECTED		**Temperature rise**	**Info Source Ref**			
		303, 314, 404, 410, 412, 414		**Likelihood**	**Level of consequence**	**Score**
All Water Treatment	T10	Increased algal growth and risk of microscopic organisms within the water supply system **increases drinking water quality risk**	**318**	4	3	**12**
	T11	Higher average and peak temperatures affect structures, buildings, H & V, MEICA plant working life, causing **accelerated asset deterioration**		3	4	**12**
Treatment works	T12	Higher temperatures reduce raw water quality and **increase drinking water quality risk**	**318**	3	3	**9**
Distribution networks including ancillaries	T20	Greater extremities in wetting and drying cycles lead to greater soil movement, causing pipe systems to move **increasing burst frequency**	**304**	3	3	**9**
	T57	Higher average and peak temperatures affect structures, buildings, H & V, MEICA plant working life, causing **accelerated asset deterioration**		3	3	**9**
ASSET AFFECTED		**Floods (higher rainfall)**	**Info Source Ref**			
Water Resources - All		All Flood Impacts				
	Impact	**104,205,206,207,314,303, 402,404, 410, 412,414,**		**Likelihood**	**Level of consequence**	**Score**
All Water Resources	F1	Direct asset flooding causes **service failure and asset loss**	**201, 215, 304, 406**	2	5	**10**
All Water Treatment	F11	Direct asset flooding causes **service failure and asset loss**	**201, 215, 304, 406**	2	5	**10**
	F12	Increased storm frequency increases frequency of power loss, causing **service failure**	**201, 215, 304, 406**	3	3	**9**
All Water Networks	F17	Direct asset flooding causes **service failure and asset loss**	**201, 215, 304, 406**	2	5	**10**
All Site wide Services	F51	Direct flooding leads to submersion of electrical assets, increasing risk to operatives of electrocution **endangering H&S of site staff**		3	5	**15**
SCADA & Telemetry	F52	Flooding causes loss of SCADA and /or telemetry causing a **service loss**		3	3	**9**

ASSET AFFECTED		Sea level rise (incl. storm surge)	Info Source Ref			
	Impact	**104,205,206,207,231, 314,303,402,404, 410, 412,414,**		**Likelihood**	**Level of consequence**	**Score**
All Water Resources	S1	Direct asset flooding, storm damage and coastal erosion or 'planned retreat' cause **service failure and asset loss**		2	5	**10**
	S2	Saline intrusion degrades infrastructure, causing **accelerated asset deterioration**		2	5	**10**

Table 3.3 2080's Long term risk

ASSET AFFECTED		Droughts (lower rainfall)	Info Source Ref			
		All Drought Impacts				
	Impact	**105, 106, 108, 209, 213, 223, 303, 314, 404, 410, 412, 414**		**Likelihood**	**Level of consequence**	**Score**
	D2	Daily & peak demand for 'garden' watering increases, causing **a reduction in security of supply**	**117, 401**	3	5	**15**
	D4	Lower river yields, borehole yields or reduced water quality lead to abstraction licences being reduced or removed, causing a **reduction in security of supply**	**224, 405, 416, 417**	3	5	**15**
ASSET AFFECTED		**Floods (higher rainfall)**	**Info Source Ref**			
	Impact	**104,205,206,207,314,303, 402,404, 410, 412,414,**		**Likelihood**	**Level of consequence**	**Score**
All Water Resources	F1	Direct asset flooding causes **service failure and asset loss**	**201, 215, 304, 406**	3	5	**15**
All Water Treatment	F11	Direct asset flooding causes **service failure and asset loss**	**201, 215, 304, 406**	4	5	**20**
All Water Networks	F17	Direct asset flooding causes **service failure and asset loss**	**201, 215, 304, 406**	3	5	**15**
	F51	Direct flooding leads to submersion of electrical assets, increasing risk to operatives of electrocution **endangering H&S of site staff**		3	5	**15**
ASSET AFFECTED		**Sea level rise (incl. storm surge)**	**Info Source Ref**			
	Impact	**104,205,206,207,231, 314,303,402,404, 410, 412,414,**		**Likelihood**	**Level of consequence**	**Score**
All Water Resources	S1	Direct asset flooding, storm damage and coastal erosion or 'planned retreat' cause **service failure and asset loss**		3	5	**15**
	S2	Saline intrusion degrades infrastructure, causing **accelerated asset deterioration**		3	5	**15**

Appendix 4 List of references for Water UK report: a Climate Change Adaptation Approach for Asset Management Planning 41414874 V1.0

REF	INFO SOURCE	TYPE	IMPACT	LINK
101	**Defra** Adaptation Policy Framework	Guidelines & Regulations	All	http://www.Defra.gov.uk/environment/climatechange/uk/adapt/policyframe.htm
102	**Defra** Climate Change Bill (consultation to June 2007)	Guidelines & Regulations	All	http://www.Defra.gov.uk/corporate/consult/climatechange-bill/
103	**Defra** Government Water Strategy (under development)	Guidelines & Regulations	All	http://www.Defra.gov.uk/environment/water/strategy/index.htm
104	**DEFRA** Making Space for Water : Taking forward a new Government strategy for flood & coastal erosion risk management	Guidelines & Regulations	Flooding	http://www.defra.gov.uk/environ/fcd/policy/strategy.htm
105	**EA Water Resource Planning Guidelines -** Draft Protocol Guidance on accounting for climate change implications in estimates of water resource zone deployable output for PR09	Guidelines & Regulations	Drought	Contact Environment Agency
106	**EA** Water Resource Planning Guidelines (April 2007). Chapter 8 Climate Change	Guidelines & Regulations	Drought	http://www.environment-agency.gov.uk/commondata/acrobat/chapter_08__30april_1752383.pdf
107	**EA** Water Resource Planning Guidelines (April 2007). Chapter 11 Options Appraisal	Guidelines & Regulations	Drought	http://www.environment-agency.gov.uk/commondata/acrobat/chapter_08__30april_1752383.pdf
108	**EA** Water Resources Strategy for England and Wales - consultation	Guidelines & Regulations	Drought	Available from Environment Agency
109	**EU** Floods Directive - Explanatory Memorandum	Guidelines & Regulations	Flooding	http://www.defra.gov.uk/environ/fcd/eufldir/explmemo.pdf
110	**EU** Water Framework Directive	Guidelines & Regulations	All	http://ec.europa.eu/environment/water/water-framework/index_en.html
112	**Scottish Parliament** Water Environment and Water Services (Scotland) Act 2003,	Guidelines & Regulations	All	http://www.opsi.gov.uk/legislation/scotland/acts2005/20050003.htm
113	**UK Government** Planning Policy Statement (PPS)25: Flooding	Guidelines & Regulations	Flooding	http://www.communities.gov.uk/planningandbuilding/planning/planningpolicyguidance/planningpolicystatements/planningpolicystatements/pps25/

114	**Welsh Assembly** Environment Strategy for Wales	Guidelines & Regulations	All	http://new.wales.gov.uk/topics/environmentcountryside/epq/Envstratforwales/About_the_strategy/?lang=en
115	**EU** Green Paper on Climate Change & Adaptation - July 2007	Guidelines & Regulations	All	http://ec.europa.eu/environment/climat/adaptation/index_en.htm
116	**OFWAT** Water Efficiency Targets for PR09	Guidelines & Regulations	Drought	Available from OFWAT
117	**HMG** Sustainable Communities	Guidelines & regulations	Drought	http://www.communities.gov.uk/publications/communities/sustainablecommunitiesbuilding
201	**CEH Wallingford** Flood Estimation Handbook	Tools & Guidance	Flooding	http://www.nwl.ac.uk/ih/feh/html/handbook.html
202	**CIRIA** Designing for exceedance in urban drainage systems - good practice	Tools & Guidance	Flooding	http://www.ciria.org/downloads
203	**CIRIA** Guidance on SUDS	Tools & Guidance	Flooding	http://www.ciria.org/downloads
204	**CIRIA** Publications on flood proofing homes	Tools & Guidance	Flooding	http://www.ciria.org/downloads
205	**Defra** Developing a Broader Portfolio of Options to Deliver Flooding and Coastal Solutions	Tools & Guidance	Flooding Sea Level Rise/Storm Surge	http://www.defra.gov.uk/environ/fcd/policy/strategy/sd2.htm
207	**Defra** Integrated Coastal Zone Management,	Tools & Guidance	Sea Level Rise/Storm Surge	http://www.defra.gov.uk/environment/water/marine/uk/iczm/index.htm
208	**Defra** Shoreline Management Plans	Tools & Guidance	Sea Level Rise/Storm Surge	http://www.defra.gov.uk/environ/fcd/policy/smp.htm
209	**Defra:** Climate Change Impacts and Adaptation: cross-regional research programme Project C	Tools & Guidance	Drought	http://www.futuredrought.org.uk/defra_Home.htm
210	**EA** Database of River Flows	Tools & Guidance	Flooding	Available from EA
211	**EA** NAFRA Infrastructure Jul 06	Tools & Guidance	Flooding	Available from EA
212	**EA** National Asset Flood Risk Assessment (NAFRA)	Tools & Guidance	Flooding	Available from EA
213	**EA** The impacts of Climate Change on Severe Droughts - implications for decision making	Tools & Guidance	Drought	Available from EA
214	**EA/Defra/Welsh Assembly** Catchment Flood Management Plans	Tools & Guidance	Flooding	http://www.environment-agency.gov.uk/yourenv/consultations/747031/?version=1&lang=_e
215	**FHRC** Mutli-Coloured Manual - flood damage costs to utilities	Tools & Guidance	Flooding	http://www.fhrc.mdx.ac.uk/resources/publications.html
216	**Local Government** Strategic Flood Risk Assessment	Tools & Guidance	Flooding	Various Local implementations
217	**Natural England** Climate Change Strategy	Tools & Guidance	All	http://www.naturalengland.org.uk/about/board/jun07/060607-NEB%20P07%2019%20-%20Final.pdf

218	**SPRU** Business and Climate Change: Measuring and Enhancing Adaptive Capacity	Tools & Guidance	All	http://www.tyndall.ac.uk/research/theme3/final_reports/it1_23.pdf
219	**UKCIP** Adaptation Database	Tools & Guidance	All	http://www.ukcip.org.uk/resources/tools/database.asp
220	**UKCIP** Adaptation Wizard	Tools & Guidance	All	http://www.ukcip.org.uk/resources/tools/adapt.asp
221	**UKCIP** Identifying Adaptation Options	Tools & Guidance	All	http://www.ukcip.org.uk/resources/tools/documents/Identifying_Adaptation_options_new.pdf
222	**UKWIR CL/01 (**Atkins) Towards a UK Water Industry Strategic Framework for Adapting to Climate Change (due Mar 08)	Tools & Guidance	All	Under development
223	**UKWIR CL/04/**C ; Effect of climate change on river flows and groundwater recharge, A practical methodology	Tools & Guidance	Drought	Purchase from UKWIR at http://www.ukwir.org/site/web/content/reports/reports?FolderId=90265
224	**UKWIR** Effects of Climate Change on River Flows and Groundwater Recharge: Guidelines for Resource Assessment and UKWIR06 Scenarios (06/**CL/04**/8)	Tools & Guidance	Drought	Purchase from UKWIR at http://www.ukwir.org/site/web/content/reports/reports?FolderId=90265
225	**Univ of Bradford** AUDACIOUS: Developing decision-making Framework for mitigating effects on Climate change on urban drainage systems	Tools & Guidance	Flooding	http://www.eng.brad.ac.uk/audacious/AIM.html
226	**WRc** Sewer Rehabilitation Manual -under revision	Tools & Guidance	Flooding	http://www.wrcplc.co.uk/srm/html/purchase.htm
227	**WRc** Sewers for Adoption (6th edition)	Tools & Guidance	Flooding	http://www.wrcplc.co.uk/srm/html/purchase
228	**OFWAT** Water Efficiency Initiatives - Good Practice Register	Tools & Guidance	All	http://www.ofwat.gov.uk/aptrix/ofwat/publish.nsf/AttachmentsByTitle/goodpracticeregister_2007.pdf/$FILE/goodpracticeregister_2007.pdf
229	**Defra -** Cost of Carbon	Tools & Guidance	All	http://www.defra.gov.uk/environment/climatechange/research/carboncost/pdf/HowtouseSPC.pdf
230	**WWF** Waste not Want Not - Sustainable Water Tariffs -	Tools & Guidance	All	http://www.wwf.org.uk/filelibrary/pdf/water_tariffs_report01.pdf
232	Water UK - CO2 measurement methodology	Tools & Guidance	All	In progress, contact via Brice Horton, Water UK
233	**EA** carbon calculator for construction activities	Tools & Guidance	All	http://www.environment-agency.gov.uk/commondata/103601/carbon_calculator_2_1883909.xls
234	**EA** Flood Risk Maps	Tools & Guidance	All	Available from Environment Agency

301	**DEFRA** Integrated Urban Drainage Pilot Studies	Research	Flooding	http://www.defra.gov.uk/environ/fcd/policy/strategy/ha2pilot.pdf
302	**Defra/CLG/EA** Water Neutrality - Managing demand in Thames Gateway. TCPA briefing	Research	Drought	Available from Defra
303	**EA** Climate Change Impacts and Costs - Summary	Research	All	Available from Environment Agency
304	**EA** Hidden Infrastructure	Research	Drought Flooding	Available from Environment Agency
306	**EA** Lessons Learned - Autumn 2000 Floods	Research	Flooding	http://www.environment-agency.gov.uk/subjects/flood/351186/351222/351275/111822/126751
307	**EEA** Climate Change and Water Adaptation	Research	All	http://reports.eea.europa.eu/technical_report_2007_2/en/eea_technical_report_2_2007.pdf
308	**FRMRC** Flood Risk Management Research Consortium outputs	Research	Flooding	Outputs from: http://www.floodrisk.org.uk/
309	**Cabinet Office** Lessons Learned - Summer 2007 Floods (interim report due Autumn / Winter 07)	Research	Flooding	Access latest information: http://www.cabinetoffice.gov.uk/floodingreview/terms_of_reference.aspx
309a	**UKWIR** - A Common Framework for Capital Maintenance Planning	Research	All	Purchase from: http://www.ukwir.org/content/default.asp?PageId=39681
310	**UKWIR** - (Tynemarch) Review of Common Framework	Research	All	http://www.tynemarch.co.uk/commonframeworkreview.shtml - is comment site accessible through password.
311	**UKWIR** - Climate Change Catalogue	Research	All	http://www.ukwir.org/content/default.asp?PageId=39681
312	**UKWIR** CL06 Effects of Climate Change on River Water Quality	Research	Drought Temperature Rise	Purchase from UKWIR at http://www.ukwir.org/site/web/content/reports/reports?FolderId=90265
313	**UKWIR** Climate Change and the Hydraulic Design of Sewerage Systems: (03/CL/10/)	Research	Flooding	Purchase from UKWIR at http://www.ukwir.org/site/web/content/reports/reports?FolderId=90265
314	**UKWIR** Climate Change, the Aquatic Environment and the Water Framework Directive CL06	Research	Drought Flooding Sea Level Rise/Storm Surge	Purchase from UKWIR at http://www.ukwir.org/site/web/content/reports/reports?FolderId=90265
317	**UKWIR CL/10 Updating -** Scoping Project on Climate Change and Urban Drainage	Research	Flooding	Under development (due end 2008)
318	**WHO** Climate change and human health - risks and responses.	Research	All	http://www.who.int/globalchange/publications/cchhsummary/en/
319	**Defra** Air Quality and Climate Change: A UK Perspective	Research	All	http://www.defra.gov.uk/environment/airquality/publications/airqual-climatechange/pdf/contents-execsumm.pdf
320	**UKWIR** Vision 20/20	Research	All	http://www.ukwir.org/files/UKWIR/R%26D%20Roadmap%20-%2018-06-07.pdf

321	UKWIR Workbook for Quantifying GHG Emissions 05/CL/01/03	Research	All	Purchase from UKWIR at http://www.ukwir.org/site/web/content/reports/reports?FolderId=90265
322	UKWIR Long Term/ Least Cost Planning for Wastewater Supply-Demand (07/RG/08/2)	Research	Flooding	Purchase from UKWIR at http://www.ukwir.org/ukwirlibrary/91714
401	**Defra** Climate Change and Demand for Water Revisited (2006)	Data & Scenarios	Drought	http://www.defra.gov.uk/science/Project_Data/DocumentLibrary/WT01001/WT01001_2050_FRP.pdf
402	**Defra** Flood and Coastal Defence Appraisal Guidance. Supplementary Note - Climate Change Impacts Nov 2006	Data & Scenarios	Flooding Sea Level Rise/Storm Surge	http://www.defra.gov.uk/environ/fcd/pubs/pagn/climatechangeupdate.pdf
404	**EA** Addressing Climate variability and change up to the 2030s	Data & Scenarios	All	Available from Environment Agency
405	**EA** guidelines for implementation of CL/04/C	Data & Scenarios	All	Available from Environment Agency
406	**Office of Science & Technology** Foresight: Climate Change, Flooding and Coastal Defence	Data & Scenarios	Flooding Sea Level Rise/Storm Surge	http://www.foresight.gov.uk/previous_projects/flood_and_coastal_defence/Reports_and_Publications/index.html
409	**PRUDENCE**	Data & Scenarios	All	http://www.cru.uea.ac.uk/projects/mps/html/prudence.html
410	**Hadeley Centre** Handling uncertainty in the UKCIP02 scenarios of climate change	Data & Scenarios	All	http://www.ukcip.org.uk/scenarios/guidance/documents/HandlinguncertaintiesinUKCIP02.pdf
411	**UKCIP** socio-economic scenarios	Data & Scenarios	All	http://data.ukcip.org.uk/resources/publications/documents/34.pdf
412	**UKCIP02**	Data & Scenarios	All	http://www.ukcip.org.uk/scenarios/ukcip02/documentation/
413	**UKCIP08**	Data & Scenarios	All	http://www.ukcip.org.uk/scenarios/ukcip08/what_is_ukcip08.asp
414	**UKWIR 06** Scenarios	Data & Scenarios	Drought	http://www.k4cc.org/events/Members/Claire/VidalAndWade.pdf
415	**UKWIR** CL04C	Data & Scenarios	Drought	Purchase from UKWIR at http://www.ukwir.org/site/web/content/reports/reports?FolderId=90265
416	**UKWIR** Climate Change Uncertainty in Water Resource Planning (05/CL/04/4)	Data & Scenarios	Drought	Purchase from UKWIR at http://www.ukwir.org/site/web/content/reports/reports?FolderId=90265
417	**UKWIR** Effect of Climate Change on River Flows and Groundwater Recharge UKCIP 02 Scenarios (03/CL/04/2)	Data & Scenarios	Drought	Purchase from UKWIR at http://www.ukwir.org/site/web/content/reports/reports?FolderId=90265